Appendix H4. California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane

Draft

California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane

Prepared for:

California State Water Resources Control Board
Division of Water Rights
and
U.S. Army Corps of Engineers
Sacramento District

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Section 1. Introduction

ASSESSMENT OBJECTIVE

To assist the California State Water Resources Control Board (SWRCB) in complying with the California Endangered Species Act, this report assesses the impacts of the proposed project of Delta Wetlands Properties (DW) on two state-listed threatened species: Swainson's hawk (*Buteo swainsoni*) and greater sandhill crane (*Grus canadensis tabida*). For this report, DW requested and the California Department of Fish and Game (DFG) provided a list of state-listed threatened or endangered species that may occur on the DW project islands. Swainson's hawk and greater sandhill crane are the only state-listed species known to occur regularly on the DW project islands.

Bald eagle (state listed as endangered), American peregrine falcon (state listed as endangered), Aleutian Canada goose (state listed as endangered), and giant garter snake (state listed as threatened) are also listed as endangered or threatened species under the federal Endangered Species Act. Potential impacts of the proposed project on these species, therefore, were assessed to comply with provisions of both the California and federal Endangered Species Acts and are described in the 1995 report Draft Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species (Jones & Stokes Associates [JSA] 1995), which is hereby incorporated by reference.

Development of the DW project would convert approximately 11,000 acres of agricultural land in the central Sacramento-San Joaquin Delta (Delta) to water storage use. Much of the DW project area is potential habitat for Swainson's hawks and greater sandhill cranes. Because these species are known to occur in the Delta and surrounding lands and because they rely on agricultural lands as foraging habitat, the project could affect local and regional Swainson's hawk and greater sandhill crane populations. This report supplements the environmental impact report/environmental impact statement (EIR/EIS) by providing a more complete analysis of the direct and indirect impacts of the proposed project on both the local and regional Swainson's hawk and greater sandhill crane populations in the Delta and surrounding areas.

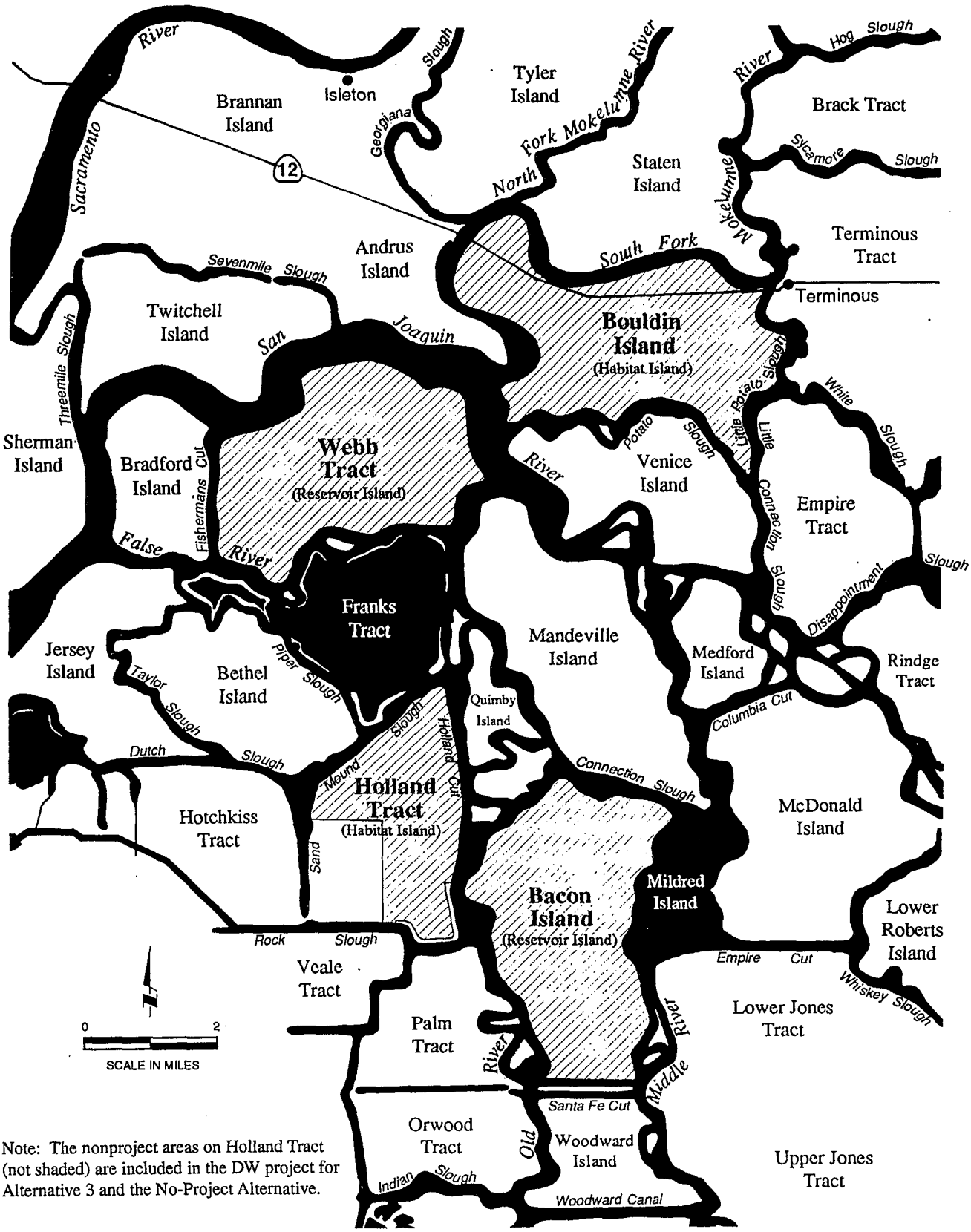
The California Endangered Species Act requires that state lead agencies consult with the DFG when preparing California Environmental Quality Act (CEQA) documents to ensure that any action authorized, funded, or carried out by the lead agency is not likely to jeopardize the continued existence of any listed species. DW has applied for discretionary permits from SWRCB; SWRCB is the lead agency for CEQA purposes for the DW project. This report provides a biological assessment (BA) for SWRCB's submittal to DFG to determine whether the DW project would affect the continued existence of the Swainson's hawk or greater sandhill crane. This BA and the analysis provided in the draft EIR/EIS are submitted to DFG to allow DFG to make its determinations regarding whether SWRCB issuance of permits to DW could likely cause jeopardy to the two listed species. Two separate BAs are also being prepared for winter-run chinook salmon and delta smelt to comply with the federal Endangered Species Act and California Endangered Species Act requirements and for federally listed wildlife species to comply with the federal Endangered Species Act. These BAs will be submitted to U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and DFG separately.

PROJECT DESCRIPTION

DW proposes to divert and store flows of water on two islands (Bacon Island and Webb Tract) in the Delta. Two additional islands (Bouldin Island and Holland Tract) would be dedicated primarily to management for wetland and wildlife habitat values to offset biological impacts resulting from the project. Details of the proposed project are described in Chapter 2, "Delta Wetlands Project Alternatives", of the EIR/EIS. The water storage islands, hereafter referred to as reservoir islands, encompass approximately 11,000 acres of agricultural land in the central Delta (Figure 1-1). The wetland and wildlife management islands, hereafter referred to as habitat islands, encompass approximately 9,000 acres of agricultural land.

Stored water would be pumped from the reservoir islands into the Delta for sale and/or release for Delta export or to meet water quality or flow requirements. Although reservoir islands would be operated primarily for water storage, the reservoir bottoms would include inner levee systems and could be managed during periods of nonstorage for shallow-water wetland values.

Habitat islands would be managed primarily for wetland and wildlife values. The islands would be developed into a mosaic of habitat types for a variety of wildlife, with an emphasis on offsetting project impacts on state-listed species. DW may use the habitat islands for incidental water storage only if such use would be consistent with management objectives for wildlife habitat on the habitat islands.



Note: The nonproject areas on Holland Tract (not shaded) are included in the DW project for Alternative 3 and the No-Project Alternative.

Source: Adapted from California Department of Water Resources 1993.

Figure 1-1.
DW Project Islands

DELTA WETLANDS PROJECT
Prepared by: Jones & Stokes Associates

C-062365

Section 2. Analysis of Impacts of the Delta Wetlands Project on the Swainson's Hawk

SPECIES DESCRIPTION

Status and Distribution

The Swainson's hawk was described in early accounts as one of the most common raptors in California (Sharp 1902). The species was found throughout much of lowland California, hunting in open grassland habitats and nesting along the edges of riparian forests or oak woodlands, or in isolated trees that were scattered across the valley savannas.

Pre-agricultural California supported abundant woodland and grassland habitats, particularly throughout the Central Valley. Since the mid-1800s, these native habitats have undergone a gradual conversion to agricultural uses. Today, native grassland habitats are much reduced in the state, and only remnants of the once vast riparian forests and oak woodlands still exist (Katibah 1983).

The effect of widespread loss of both nesting and foraging habitats on Swainson's hawks has been a significant reduction of the breeding range (Figure 2-1) and the breeding population in California (Bloom 1980). The state currently supports an estimated 550 breeding pairs of Swainson's hawks, representing less than 10% of the historical population (DFG 1988). To provide protection for the remaining population, the State of California listed the Swainson's hawk as a threatened species in 1983.

The largest segment of the California Swainson's hawk population exists in the Central Valley, where an estimated 440 pairs nest (DFG 1988) (Figure 2-2). Although agricultural conversion of native habitats was probably the primary factor responsible for initial Swainson's hawk declines in the state (other factors may have also contributed, such as shooting and unknown problems on the hawk's South American wintering grounds), certain agricultural practices are largely responsible for maintaining current populations. The row, grain, and hay crop farming typical of the mid-section of the Central Valley is compatible with Swainson's hawk foraging habitat needs. The distribution of the Central Valley population is closely correlated with the distribution of these cropping patterns (Figure 2-3). This region of suitable agricultural foraging habitat is considered essential in maintaining the stability of the Central Valley Swainson's hawk population.

Habitat Requirements

Nesting

Swainson's hawks usually nest in large, mature trees. Native trees are almost always used, although nests have been found in eucalyptus (*Eucalyptus* sp.) trees and ornamental conifers. Tree species most commonly used in the Central Valley in decreasing order of frequency include valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), black walnut (*Juglans hindsii*), and willow (*Salix* sp). Nests are usually constructed high in the tree to provide the nesting pair a panoramic view of their territory. Nests are usually of flimsy construction and often blow out of the nest tree during high winds, particularly during winter.

Although nest sites are not found exclusively in riparian habitat, more than 87% of the known nest sites in the Central Valley are within riparian systems (Schlorff and Bloom 1984, Estep 1984). Swainson's hawks also nest in roadside trees, isolated individual trees, and small groves and on the edges of remnant oak woodlands.

Swainson's hawks are highly traditional in their use of nesting territories, returning each year to the same nest tree or a tree nearby. Many nest sites in the Central Valley have been monitored annually since 1978, and a program of color-banding nesting pairs has been ongoing since 1986. These studies show a high degree of nest site and mate fidelity among pairs (Estep unpublished data).

Foraging

The Swainson's hawk is adapted to foraging in large, open plains and grasslands. In the Central Valley, how-

ever, virtually all native foraging habitat has been converted to agricultural uses, restricting Swainson's hawks to areas that support cropping patterns compatible with their foraging requirements. Both the abundance of prey populations and the accessibility of prey to foraging birds determine the suitability and quality of agricultural foraging habitat for Swainson's hawks. The many crop types grown in the Central Valley differ widely with respect to their foraging habitat suitability.

Swainson's hawks hunt aerially almost exclusively in the Central Valley, soaring from 100 feet to 300 feet above the ground while scanning for prey (Estep 1989). Foraging birds select fields that are most compatible with this type of foraging behavior (i.e., fields that are large, support low cover to provide access to the ground, and provide the highest densities of accessible prey). These habitats include fields of hay and grain crops; lightly grazed pasturelands; and fields of certain row crops, such as tomatoes and sugar beets. Fields lacking adequate prey populations, such as flooded rice fields, or those that are inaccessible to foraging birds, such as vineyards and orchards, are avoided.

Cropping patterns directly affect the foraging behavior, foraging range size, and ultimately the reproductive success of nesting Swainson's hawks. As crops mature, vegetative cover increases, which decreases prey accessibility; as a result, foraging birds expand their ranges in search of fields that provide accessible prey. Foraging Swainson's hawks have been observed traveling more than 10 miles from their nest in search of prey (Estep 1989, Michael Brandman Associates 1993). Later in the season, as crops are harvested, foraging ranges decrease as prey become more accessible near the nest. Prey abundance has also increased by the time harvesting operations proceed. The result is that foraging ranges can fluctuate both seasonally, in response to changes in prey accessibility and abundance, and from year to year in response to changing cropping patterns. Overall foraging ranges (averaging 6,800 acres [Estep 1989] and 9,979 acres [Michael Brandman Associates 1993]) are much larger than those of raptors that use more stable foraging environments. Table 2-1 ranks the habitat quality of various crops grown in the Central Valley as high, moderate, or low based on their value to foraging Swainson's hawks.

Reasons for Decline and Threats to the Population

The conversion of native grassland and woodland communities to agriculture is the primary reason for the initial decline of Swainson's hawk populations in California. The remaining population in the Central Valley uses areas that continue to support suitable nesting habitat and agricultural conditions compatible with their foraging requirements. The distribution of Swainson's hawks in the Central Valley is probably quite different from what it was before agriculture was introduced to California; this difference is a result of both loss of native habitats and the development of agricultural patterns throughout the region. Although Swainson's hawks appear to thrive in certain types of agricultural habitats, the Central Valley population is faced with continuing conversion of these suitable non-native habitats to unsuitable cropping patterns and urban development.

The loss of foraging habitat has only recently been evaluated as a potential impact of urban development. In the Central Valley, the loss of foraging habitat has led to the abandonment of traditional Swainson's hawk nest sites and threats to many other pairs. The continuing loss of foraging habitat in the Central Valley could contribute to further reduction in the statewide breeding population (DFG 1988).

Much of the open agricultural land in the midsection of the Central Valley is subject to urban development. Both Sacramento and San Joaquin Counties are undergoing rapid urban development. In 1990, a study in San Joaquin County predicted a 30% decline in the countywide Swainson's hawk population at buildout of the current local planning areas (JSA 1990).

STATUS OF THE SWAINSON'S HAWK IN THE DELTA

Delta Land Use

The Delta extends from Interstate 80 near Sacramento on the north to the confluence of the San Joaquin and Stanislaus Rivers on the south. The Delta is generally bordered by Interstate 5 on the east. Most of the land in the Delta area is used for agriculture, although urban development is expanding around the perimeter of the Delta and in some areas within the interior of the Delta (i.e., Discovery Bay).

Agricultural patterns in the Delta vary between the north, south, and central regions (Figure 2-4). The northern Delta, generally north of the confluence of the Mokelumne and San Joaquin Rivers, is characterized by a mixture of hay, row, and grain crops and orchards. The cropping patterns of the south Delta, generally south of

State Route 4, are dominated by hay crops north of Tracy and hay, row, and grain crops and pasturelands south of Tracy.

The DW project would be located in the central Delta, the area generally north of State Highway 4 and south of the Mokelumne River. As a result of soil and hydrologic factors, cropping patterns are more restrictive in this region than in the rest of the Delta and in the interior Central Valley. The typical pattern consists primarily of corn and wheat, with lesser amounts of asparagus, potato, sunflower, safflower, and orchards. Because these crops provide low to moderate habitat value, the central Delta is considered marginal Swainson's hawk foraging habitat compared with foraging habitat in the north and south Delta regions.

Distribution of the Swainson's Hawk

Swainson's hawks are distributed unevenly in the Delta (Figure 2-5). Although numerous nest sites exist in the north and south Delta regions, only two are known to exist in the central Delta. One factor responsible for this distribution is the lack of available nesting habitat. The north and south Delta support abundant nesting habitat, mostly riparian woodlands, roadside trees, and isolated valley oaks, while few suitable nesting trees exist in the central Delta region. Available nesting habitat in the central Delta consists of a few small, isolated groups of cottonwood and eucalyptus trees along otherwise denuded waterways.

An equally important factor affecting nesting distribution in the Delta is foraging habitat quality. Although individuals are wide ranging, Swainson's hawks typically do not nest in areas such as the central Delta, where most lands are of low foraging quality (Estep 1989).

Historically, the Delta was a system of permanent and seasonal wetlands that provided little foraging habitat for Swainson's hawks. Thus, the region probably never supported many nesting pairs. The territories that have become established in the Delta have probably done so since the conversion of wetland habitats to agriculture, which provides suitable foraging conditions.

Swainson's Hawk Use of the Central Delta

The rotation of corn and wheat, the primary cropping pattern in the central Delta, produces marginally suitable foraging habitat for Swainson's hawks. The timing of corn and wheat plantings and harvesting are complementary, providing suitable foraging conditions throughout most of the breeding season. Both corn and wheat provide foraging habitat during the early part of the breeding season. Wheat fields become less suitable in April as the crop matures. Cornfields continue to be suitable for foraging through May. As cornfields mature, they also become unsuitable, but by late June to early July, wheat is harvested and harvested wheat fields again become suitable habitat. Thus, it is possible that low- to moderate-value habitat is available to foraging Swainson's hawks on central Delta islands throughout most of the breeding season.

The central Delta also supports other row, grain, and hay crops and pastures that attract foraging Swainson's hawks. Moderate- to high-value crop types (Table 2-1) occupy only a small portion of central Delta lands, however, and are typically fragmented by larger areas of low-value or unsuitable crop patterns.

Although few Swainson's hawks are known to nest in the central Delta, individuals are occasionally observed foraging on the central Delta islands, including the DW islands, during the breeding season (Holt pers. comm.). Previous studies of foraging Swainson's hawks suggest that pairs that nest near the more marginal central Delta habitats regularly forage in the central Delta, but range over large areas. Pairs that nest outside the Delta may also forage on Delta islands during certain times of the year, particularly during periods of harvest or during periods of foraging range expansion, which occurs when prey is limited near the nest (Estep 1989).

In general, however, Swainson's hawks will limit their foraging movements to stay as close to the nest as possible (Michael Brandman Associates 1993). Thus, foraging frequency declines with distance from the nest. In most cases, nest sites are located near high-quality foraging habitat; thus, hawks will travel far from the nest only if necessary, based on both the crop patterns near the nest and availability of suitable habitat elsewhere.

Many Swainson's hawk pairs in the Central Valley rely on distant foraging habitats (e.g., 4-10 miles from the nest) when habitat suitability near the nest is reduced. The likelihood of individual Swainson's hawks regularly traveling as far as 10 miles from the nest is relatively small. Only two of 12 radiotagged birds observed by Estep (1989) traveled over 9 miles. The average maximum distance (distance from the nest to the farthest foraging area) that birds traveled was 5.3 miles.

The Delta is also used by Swainson's hawks during winter, an unusual occurrence at northern latitudes. Swainson's hawks are migratory, and most spend winters in South America. Several individuals, however, have been sighted during winter in the Delta over the last 10 years (Holt pers. comm.). In 1990-1991, a group of 29 adult Swainson's hawks was regularly observed on Bouldin Island and neighboring Venice Island for several weeks. These birds appeared to be attracted to the abundance of prey that resulted from the disking and flooding operations on the islands, and possibly to the stand of eucalyptus trees across the Mokelumne River from Bouldin Island on neighboring Tyler Island, where the group roosted for several weeks.

Flooding for weed control forces prey into smaller, confined areas, and increases prey densities and accessibility. Thus, during winter flooding, foraging suitability increases in the central Delta. In addition to Swainson's hawks, Bouldin Island supported several hundred other wintering raptors during this period, mostly red-tailed hawks (*Buteo jamaicensis*) and some rough-legged hawks (*Buteo lagopus*), ferruginous hawks (*Buteo regalis*), northern harriers (*Circus cyaneus*), black-shouldered kites (*Elanus caeruleus*), and at least one prairie falcon (*Falco mexicanus*) and one peregrine falcon (*Falco peregrinus*). After disking and flooding were completed, the group apparently dispersed throughout the Delta. Individuals and smaller groups continued to be observed on central Delta islands through February (Holt pers. comm.). Similar numbers of Swainson's hawks have also been observed in the central Delta during the winters of 1992 and 1993. The origin of this wintering population and the likelihood of it returning in subsequent years are unknown.

IMPORTANCE OF THE DELTA WETLANDS PROJECT ISLANDS TO SWAINSON'S HAWKS

Information presented in this section is based on surveys prepared in 1987-1990. No change has occurred since that time regarding circumstances on the DW islands or land use management decisions; therefore, this information generally reflects current conditions on the DW islands (unless otherwise noted).

Nesting

No Swainson's hawks are known to nest on the DW project islands. No nesting pairs were observed during surveys of all potential nesting habitat on the four islands during the 1987 breeding season and surveys of all neighboring islands in San Joaquin County in 1990 (JSA 1990). In 1993, two nest sites were found in the central Delta (Holt pers. comm.). One is on the west side of Mildred Island, within 0.25 mile of Bacon Island, and one is on Medford Island, approximately 2 miles north of Bacon Island. Fourteen additional Swainson's hawk nest sites exist within 10 miles of the DW project, the nearest of which is 3 miles northwest of Bouldin Island (Figure 2-6).

Nesting habitat on the DW islands and throughout the central Delta is limited. Most watercourses throughout the region are denuded of vegetation. The predominant potential nesting habitat consists of small groups of cottonwoods or eucalyptus trees scattered throughout the region. Riparian forest has also developed around blowout ponds on several islands.

Bacon Island and Bouldin Island support very little potential nesting habitat. Several small groups of cottonwood and eucalyptus trees are present but unoccupied. On Webb Tract, potential habitat exists in riparian habitat around two blowout ponds. On Holland Tract, potential nesting habitat exists in riparian forest around one blowout pond, several scattered lone trees, and riparian habitat along an irrigation channel. These areas are also unoccupied.

Foraging

The total acreage on the four DW islands is approximately 20,100 acres (Tables 2-2a and 2-2b). Approximately 17,175 acres are considered suitable Swainson's hawk foraging habitat based on conditions that existed in 1987 (Table 2-3). Nearly half this area, however, is low-quality foraging habitat and half is moderate-quality habitat. No high-quality habitat exists on any of the DW project islands (Table 2-4). In general, cropping patterns on the DW islands are typical of those of most of the central Delta, with a predominance of corn and wheat on all four islands and large amounts of asparagus and potatoes on Bacon Island.

Sixteen pairs of Swainson's hawks nest within 10 miles of DW islands and could forage on the islands. If foraging habitat is high quality near the 16 nest sites, the

hawks would be expected to forage primarily near the nests. Specific crop patterns on lands surrounding the nesting pairs would thus determine if and when the birds might forage on the DW project islands. These crop patterns are evaluated later in this assessment.

Bacon Island

Bacon Island consists of intensively managed agricultural operations, with nearly all tillable land in production. Agricultural crops are more diverse than on Bouldin Island and include corn, milo, potato, sunflower, asparagus, grape, kiwi, and potato seed. In 1987, the dominant annual crops were potato and corn (Figure 2-7), and approximately 355 acres were left fallow (Table 2-3).

In general, the cropping pattern on Bacon Island provides low to moderate foraging habitat conditions. The nearest known Swainson's hawk nest is immediately east of Bacon Island on Mildred Island, and seven pairs nest within 10 miles of some portion of the island. Thus, several pairs could forage on the island.

Webb Tract

Webb Tract consists of a mosaic of agricultural crops and upland pastures, with two blowout ponds and small areas of riparian or marsh habitat (Figure 2-8). In 1987, major portions of Webb Tract were under intensive agricultural production, primarily corn and wheat. Herbaceous upland and pastureland habitats made up over 15% of the island (Table 2-3).

Webb Tract is also considered low to moderate foraging habitat for Swainson's hawks. Although upland grasslands and pasturelands can provide higher value habitat, on Webb Tract these areas are small and interspersed among the cornfields and wheat fields. The nearest known nest site is approximately 4 miles from the island, and seven pairs nest within 10 miles of some portion of the island (Figure 2-6). Thus, several pairs could forage on the island.

Bouldin Island

Bouldin Island is an intensively managed, integrated agricultural operation, with corn production representing more than half the cultivated acreage in 1987 (Figure 2-9). Natural or native vegetation is virtually absent from Bouldin Island, and most tillable land is in crops; 712 acres were left fallow in 1987 under the Agricultural Stabilization and U.S. Soil Conservation Service set-aside program. Corn, sunflower, and wheat crops accounted for all agricultural production in 1987.

Approximately 12% of Bouldin Island was fallow in 1987 (Table 2-3). Although fallow fields can provide high-quality foraging habitat for Swainson's hawks, the high water table on Delta islands results in fallow fields with dense and tall vegetation with lower foraging value to Swainson's hawks. The overall quality of foraging habitat on Bouldin Island is considered low to moderate because of the predominance of corn and wheat.

Swainson's hawks have been observed foraging on Bouldin Island during the nesting season and during winter. The nearest known nest site is approximately 3 miles from the island, and 10 pairs nest within 10 miles of some portion of the island (Figure 2-5). Foraging habitat on Bouldin Island is considered low to moderate; thus, several nesting pairs could forage on the island.

Holland Tract

Agricultural management on Holland Tract is less intensive than on Bacon and Bouldin Islands and represents only about one-third of all land cover (Figure 2-10). Corn, wheat, and asparagus were the only crops grown on Holland Tract in 1987 (Table 2-3). Holland Tract is similar to Webb Tract in its mosaic pattern of intensive agriculture, irrigated pasturelands, natural uplands, and fallow fields.

Holland Tract also supports upland grassland and irrigated pastureland, although these areas are small and interspersed among low- to moderate-quality crops. Like the other DW islands, Holland Tract provides suitable Swainson's hawk foraging habitat. Seven pairs nest within 10 miles of the island (Figure 2-6), although only two known nests are located within 9 miles of the islands. Thus, although several pairs could forage on the island, it probably is less likely to be used than the other three DW islands.

IMPACTS OF THE PROJECT ON SWAINSON'S HAWKS

Because of the unique habitat requirements and behavior of the Swainson's hawk in the Central Valley, methodologies for impact assessment and the development of mitigation strategies for the species are evolving. DFG has sought mitigation for losses of Swainson's hawk foraging habitat from development projects only since

1989. Opinions vary among biologists regarding the best approach to use in assessing impacts on nesting pairs or the population.

As agreed to by SWRCB and DW, this report assesses impacts on Swainson's hawks using only the DFG mitigation approach. This approach does not specify a separate analysis for direct and cumulative impacts. Instead, DFG mitigation guidelines (DFG 1993) suggest that any loss of potential Swainson's hawk foraging habitat within 10 miles of an active Swainson's hawk nest site is subject to mitigation. Because of the level of use of the DW project islands by Swainson's hawks, the DFG approach could be considered conservative for mitigating foraging habitat impacts. DFG used the following assumptions in establishing its mitigation guidelines:

- Because Swainson's hawks will travel as far as 10 miles from their nests to forage, and because crop patterns (and thus habitat suitability) change seasonally and annually, potential Swainson's hawk habitat includes all land within a 10-mile radius of a nest.
- The loss of any potential Swainson's hawk foraging habitat is a significant impact under CEQA because under certain conditions, any portion of the area within a 10-mile radius of a nest could be essential habitat for a breeding pair.
- The loss of any potential Swainson's hawk habitat constitutes a taking under California Endangered Species Act because loss of foraging habitat affects the reproductive potential of nesting Swainson's hawks and can result in the permanent loss of breeding territories (Wernette pers. comm.).

Methods

The DFG method for assessing impacts consists of determining whether Swainson's hawk nest sites exist within 10 miles of any portion of the DW islands and determining whether the habitat on the DW islands is suitable for Swainson's hawk foraging (DFG 1993). DFG considers all hay, row, and grain crops; pasturelands; grasslands; and seasonal wetlands (dry during spring and summer) to be suitable Swainson's hawk foraging habitat. This assessment was conducted using crop-type acreages from 1988 (Tables 2-2a and 2-2b). It is assumed that cropping patterns have been generally consistent with the 1988 pattern through 1993.

Mitigation Guidelines

According to DFG guidelines, losses of all suitable foraging habitat within 1 mile of a nest should be mitigated at a ratio of 1 acre for each acre affected (i.e., for each acre of habitat lost, 1 acre of habitat is preserved and enhanced); losses of all suitable foraging habitat within 1-5 miles of a nest should be mitigated at a ratio of 0.75 acre for each acre affected; and losses of all suitable foraging habitat within 5-10 miles of a nest should be mitigated at a ratio of 0.5 acre for each acre affected. Using this approach, radii were drawn from each of the 16 nest sites within 10 miles of the DW project islands to determine compensation acreage (Figure 2-11).

Results

Impacts on Foraging Habitat of Nesting Swainson's Hawks

A total of 9,021 acres of low- to moderate-value Swainson's hawk foraging habitat would be lost as a result of Bacon Island and Webb Tract being flooded (4,006 acres on Bacon Island and 5,016 acres on Webb Tract) (Table 2-5).

Figure 2-11 shows the area within a 10-mile radius of each of the 16 nest sites on the DW reservoir islands (Bacon Island and Webb Tract). Approximately 30% of Webb Tract is within 5 miles of an active nest, and the remaining 70% is between 5 miles and 10 miles from an active nest. Approximately 10% of Bacon Island is within 1 mile of an active nest and the remaining 90% is within 5 miles of an active nest. When the DFG compensation ratios are applied to these acreages, 3,104 acres are required to compensate for impacts on Bacon Island (south Delta), and 2,884 acres are required to compensate for impacts on Webb Tract (north Delta) (Table 2-6).

Additional foraging habitat would be lost on Bouldin Island and Holland Tract as a result of implementation of the comprehensive habitat management plan (HMP), which includes creation of seasonal wetlands on the habitat islands to compensate for project effects on wetland habitats (e.g., riparian habitat, emergent marsh, exotic marsh, and pond) on the reservoir islands (Table 2-6). Under the HMP, a total of 986 acres of seasonal wetland would be created on Bouldin Island to compensate for wetland and wildlife effects of the DW project on Webb Tract. A total of 41 acres of seasonal wetland would be created on Holland Tract to compensate for wetland and

wildlife effects of the DW project on Bacon Island. Approximately 80% of Bouldin Island is within 5 miles of an active nest, and the remaining 20% is between 5 miles and 10 miles from an active nest. Approximately 90% of Holland Tract is within 5 miles of an active nest, and the remaining 10% is between 5 miles and 10 miles from an active nest (Figure 2-11).

When DFG compensation ratios are applied to impacts on Bouldin Island and Holland Tract, 690 acres are required to compensate for losses on Bouldin Island, and 30 acres are required to compensate for losses on Holland Tract.

A total of 6,708 acres are required to compensate for all project-related impacts on the Swainson's hawk.

Impacts on the Wintering Population

The DW project would result in the loss of potential foraging habitat for wintering Swainson's hawks if the species continues to visit DW islands during subsequent winters. Although Swainson's hawks generally are traditional in their migratory movements, they do not occupy specific territories during winter. They typically remain in loose groups and forage opportunistically over wide areas. They appear to forage on islands that support easily accessible prey and move to other areas as prey populations or accessibility decline.

Use of the Delta by wintering Swainson's hawks is unusual and is not fully understood. The regularity of and reasons for winter use of the Delta, and its significance to the California breeding population, are unknown. The availability of roosting sites and prey may have initially led the Swainson's hawks to stop in the Delta during fall southward migration, and the abundance of accessible prey from farming operations during fall and winter probably led the birds to remain during winter.

Use of the Delta by wintering Swainson's hawks does not depend on the DW islands. The loss of 10,048 acres of agricultural land on the DW reservoir islands would not be a substantial loss in the context of the amount of available habitat in the Delta for a small occasional number of wintering birds. Development of the DW project would probably not discourage the use of Delta agricultural habitats by wintering Swainson's hawks during subsequent years. Additionally, in the event that the loss of habitat resulting from DW project implementation discourages Swainson's hawks from remaining in the Delta during winter, the group would probably continue its migration southward toward its traditional wintering grounds.

DFG views the loss of potential winter foraging habitat as an adverse impact on the species. The rationale for this is DFG's interpretation of the California Endangered Species Act and the determination that loss of any suitable foraging habitat may affect the species. (Mensch pers. comm.) Wintering Swainson's hawks are observed regularly on Bouldin Island and occasionally on Webb Tract. No observations of wintering Swainson's hawks have been made on Bacon Island or Holland Tract.

The management of Bouldin Island as a habitat island would continue to provide suitable foraging habitat for wintering Swainson's hawks. Swainson's hawks are apparently attracted to the island because of the disking and flooding activities occurring during fall and early winter. These activities would continue on the island in the corn/wheat fields, small grain fields, mixed agriculture/seasonal wetlands, and seasonal managed wetlands. Additionally, the creation of pasture and herbaceous upland habitats under HMP implementation would provide currently nonexisting upland foraging habitat on Bouldin Island, further enhancing its wintering habitat value for Swainson's hawk and other wintering raptors.

Mitigation

A minimum of 6,708 acres of suitable habitat will be retained in perpetuity on the DW habitat islands as suitable Swainson's hawk foraging habitat. The HMP specifies that a total of 10 habitat types would be developed on each island, six of which are suitable Swainson's hawk foraging habitat (Table 2-7). Although some habitats would also be managed for waterfowl, they will be managed in a way that would provide at least moderate Swainson's hawk foraging values during spring and summer. Table 2-8 outlines management objectives and specific strategies for managing habitat islands as suitable Swainson's hawk habitat.

Although project implementation would not directly affect any nesting Swainson's hawks, an additional benefit of the project would be the restoration of 265 acres of riparian woodland and scrub habitat on Bouldin Island and Holland Tract. This would substantially increase the available nesting habitat on both habitat islands for Swainson's hawks and other nesting raptors, and potentially increase the accessibility of foraging habitats in the central Delta to Swainson's hawks.

Fully mitigating impacts on potential foraging habitat of nesting Swainson's hawks would sufficiently compensate for effects on Swainson's hawks on the DW project islands.

Conclusions

Impacts of the DW project on Swainson's hawks are assessed using the DFG Swainson's hawk mitigation guidelines. Using this approach, DW would replace 9,021 acres of mostly low-value Swainson's hawk foraging habitat on Bacon Island and Webb Tract and 1,027 acres of low- to moderate-value foraging habitat on Bouldin Island and Holland Tract with a minimum of 6,708 acres of moderate-value habitat on Bouldin Island and Holland Tract being managed during late spring and summer, specifically for Swainson's hawk use. The typical cropping pattern of corn and wheat on the habitat islands will be converted to a mosaic of 10 habitat types, six of which are suitable for Swainson's hawk foraging. Management of these cover types (corn/ wheat rotation, wheat, managed agriculture-wetland, seasonal managed wetland, pasture, and upland grassland) during spring and summer will maximize Swainson's hawk foraging use.

Implementation of the HMP on the habitat islands would offset adverse affects resulting from habitat loss on the DW project islands and reduce impacts on Swainson's hawk to a less-than-significant level.

Table 2-1. Sample of Crop Types Grown in the Central Valley and Their Rank According to Swainson's Hawk Foraging Habitat Suitability

Crop	Suitability Ranking			
	High	Moderate	Low	No Value
Grains				
Wheat		X		
Barley		X		
Rice				X
Hay Crops				
Alfalfa	X			
Oat		X		
Row Crops				
Corn			X	
Tomato		X		
Beet		X		
Milo			X	
Sunflower			X	
Safflower			X	
Asparagus				X
Bean		X		
Pepper			X	
Onion			X	
Field Crops				
Potato		X		
Orchards				X
Vineyard				X
Pasturelands				
Dryland pasture[a]	X	X		
Irrigated pasture		X		
Fallow Fields[b]	X	X		

[a] Dryland pasture value can be high or moderate, depending on grazing intensity.

[b] The value of fallow fields can be high or moderate, depending on the height and density of vegetation.

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Table 2-2a. Habitat-Type Acreages on the DW Project Islands

Name	Code[a]	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		All Islands	
		Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total
Riparian	R1	0.0	0.00	47.7	0.87	6.9	0.11	80.3	2.56	134.9	0.67
	R2	3.4	0.06	58.0	1.06	9.9	0.16	24.8	0.79	96.1	0.48
Marsh	M1	2.7	0.05	172.0	3.14	21.1	0.35	27.8	0.89	223.5	1.11
	M3	30.4	0.55	783.3	14.32	114.7	1.92	195.5	6.24	1,123.9	5.58
Woody, non-native	W1	0.0	0.00	0.0	0.00	2.8	0.05	4.4	0.14	7.2	0.04
	W2	0.0	0.00	0.0	0.00	2.2	0.04	0.0	0.00	2.2	0.01
Herbaceous upland	H1	260.8	4.71	534.6	9.77	349.1	5.83	369.0	11.77	1,513.5	7.52
	H2	267.6	4.83	304.2	5.56	0.0	0.0	263.8	8.41	835.6	4.15
Agriculture	A1 (corn)	775.8	14.00	2,222.9	40.64	2,459.2	41.09	131.8	4.20	5,589.7	27.77
	A1 (wheat)	0.0	0.00	445.0	8.14	1,182.8	19.76	482.5	15.39	2,110.3	10.48
	A1 (milo)	83.6	1.51	0.0	0.00	0.0	0.00	0.0	0.00	83.6	0.42
	A1 (potato)	1,882.6	33.99	0.0	0.00	0.0	0.00	0.0	0.00	1,882.6	9.35
	A1 (sunflower)	190.7	3.44	0.0	0.00	888.3	14.84	0.0	0.00	1,079.0	5.36
	A1 (unknown)	158.8	2.87	26.8	0.49	0.0	0.00	0.0	0.00	185.6	0.92
	A1 subtotal	3,091.5	55.81	2,694.7	49.27	4,530.3	75.69	614.3	19.59	10,930.8	54.30
	A2 (asparagus)	1,069.1	19.30	0.0	0.00	0.0	0.00.	423.0	13.49	1,492.1	7.41
	A2 (vineyard)	278.4	5.03	0.0	0.00	0.0	0.00	0.0	0.00	278.4	1.38
	A2 subtotal	1,347.5	24.33	0.0	0.00	0.0	0.00	423.0	13.49	1,770.5	8.80
	A3	0.0	0.00	61.0	1.12	34.2	0.57	349.8	11.16	445.0	2.21
	A5 (fallow)	355.3	6.41	637.9	11.66	711.6	11.89	689.1	21.98	2,394.0	11.89
Open water	O1	91.8	1.66	49.7	0.91	118.1	1.97	39.4	1.26	299.0	1.49
	O2	1.5	0.03	105.7	1.93	0.0	0.00	16.6	0.53	123.8	0.62
	O3	1.2	0.02	0.0	0.0	9.3	0.16	0.0	0.00	10.5	0.05
Developed	D1	12.6	0.23	1.5	0.03	4.2	0.07	9.0	0.29	27.3	0.14
	D2	73.1	1.32	18.7	0.34	70.6	1.18	28.4	0.91	190.8	0.95
Total		5,539.4	100.00	5,469.0	100.00	5,985.0	100.00	3,135.2	100.00	20,128.6	100.00

Notes: This table was revised April 5, 1994.

Minor discrepancies in totals are due to rounding.

[a] See Table 2-2b for habitat-type descriptions.

Table 2-2b. Habitat-Type Classifications for the DW Project Islands

Name	Code	Description	Comments	Dominant or Typical Plant Species
Riparian	R1	Cottonwood-willow woodland	Cottonwood and willow trees	Fremont cottonwood, red willow, yellow willow
	R2	Great Valley willow scrub		Red willow, yellow willow, sandbar willow, Goodding's willow
Marsh	M2	Freshwater marsh	Inside islands	Cattail, bulrush, yellow nutsedge, pondweed, buttonbush
	M2	Tidal marsh	Outside main islands	Common tule, common reed, Olney's bulrush, California bulrush, common rush
	M3	Exotic marsh[a]	Dense upland and wetland weeds (sometimes dry in summer)	Annual smartweed, peppergrass, amaranth, wild radish, nettles, cocklebur, watergrass
Woody, non-native	W1	Mature trees	Shade trees and windbreaks	Eucalyptus, pine, elm
	W2	Mixed ornamental	Shrubs and lawn	Turf grasses, miscellaneous ornamental shrubs
Herbaceous upland	H1	Annual grassland	True uplands and sand hills	Wild oats, barley, rip-gut brome, Italian rye-grass
	H2	Exotic perennial grassland[a]	Mixed weeds in fields and on levee slopes	Bermuda grass, perennial ryegrass, Johnson grass
Agriculture	A1	Grain and seed crops		Corn, wheat, sunflowers, potatoes
	A2	Perennial crops		Asparagus, vineyards
	A3	Pasture	Permanently grazed	Tall fescue, orchard grass, canary grass, ryegrass, legumes
	A4	Waterfowl food crops	Managed wetlands	Smartweed, watergrass, bulrush
	A5	Fallow	Short-term fallow fields	Yellow star-thistle, Russian thistle, houseweed, lamb's quarters, telegraph weed
Open water	O1	Canals and ditches	Permanent water	Dallis grass, knot grass, Himalaya berry, smartweed
	O2	Permanent ponds	Still water	Water hyacinth, water primrose, azolla
	O3	Mudflats	Tidal, open bare mud	None
Developed	D1	Structures	Buildings and marinas	
	D2	Paving and exposed earth	Roads, landfills, and unvegetated exposed areas	Largely unvegetated

[a] Exotic habitats are dominated by weedy plant species that are not native to the Delta.

Source: JSA 1988.

Table 2-3. Suitable Foraging Habitat Types for Swainson's Hawk on the DW Project Islands

Crop/ Cover Type	Suitability Rank[a]	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		All Islands	
		Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total	Acres	Percentage of Total
Corn	L	775.8	19.2	2,222.9	44.3	2,459.2	42.8	131.8	5.5	5,589.7	32.5
Wheat	M	0.0	0.0	445.0	8.9	1,182.8	20.6	482.5	20.0	2,110.3	12.3
Milo	L	83.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	83.6	0.5
Potato	M	1,882.6	47.0	0.0	0.0	0.0	0.0	0.0	0.0	1,882.6	11.0
Sunflower	L	190.7	4.8	0.0	0.0	888.3	15.5	0.0	0.0	1,079.0	6.3
Pasture[b]	M	0.0	0.0	61.0	1.2	34.2	0.6	349.8	14.5	445.0	2.6
Herbaceous upland[b]	M	528.4	13.2	838.8	16.7	349.1	6.1	564.1	23.4	2,280.4	13.3
Fallow	M	355.3	8.9	637.9	12.72	711.6	12.4	689.1	28.6	2,393.9	13.9
Exotic marsh[b]	L	30.4	0.8	783.3	15.6	114.7	2.0	195.5	8.1	1,123.9	6.5
Unknown agriculture	L	158.8	4.0	26.8	0.5	0.0	0.0	0.0	0.0	185.6	1.1
Total		4,005.6	100.0	5,015.7	100.0	5,739.9	100.0	2,412.8	100.0	17,174.0	100.0

Note: Minor discrepancies in totals are the result of rounding.

[a] Suitability rank definitions:
L = Low
M = Moderate

[b] See Table 2-2b for crop/cover type definitions.

Table 2-4. Summary of DW Project Island Acreages by Suitability Rankings for Suitable Swainson's Hawk Foraging Habitat

Island	Acres by Habitat Suitability Rank			
	High	Moderate	Low	Total
Bacon	0.0	2,766.3	1,239.3	4,005.6
Webb	0.0	1,982.7	3,033.0	5,015.7
Bouldin	0.0	2,277.7	3,462.2	5,739.9
Holland	0.0	2,085.5	327.3	2,412.8
Total	0.0	9,112.2	8,061.8	17,174.0

Table 2-5. Acreages of Suitable Swainson's Hawk Foraging Habitat Types on the DW Reservoir Islands

Habitat	Suitable for Swainson's Hawk	Bacon Island	Webb Tract	Total
Riparian woodland		0.0	47.7	47.7
Riparian scrub		3.4	58.0	61.4
Emergent marsh		2.7	172.0	174.7
Exotic marsh	X	30.4	783.3	813.7
Annual grassland	X	260.8	534.6	795.4
Exotic perennial grassland	X	267.6	304.2	571.8
Corn	X	775.8	2,222.9	2,998.7
Wheat	X	0.0	445.0	445.0
Milo	X	83.6	0.0	83.6
Potato	X	1,882.6	0.0	1,882.6
Sunflower	X	190.7	0.0	190.7
Asparagus		1,069.1	0.0	1,069.1
Vineyard		278.4	0.0	278.4
Pasture	X	0.0	61.0	61.0
Unknown agriculture	X	158.8	26.8	185.6
Fallow	X	355.3	637.9	993.2
Sloughs and ditches		91.8	49.7	141.5
Ponds		1.5	105.7	107.2
Structures		12.6	1.5	14.1
Roads and landfills		73.1	18.7	91.8
Total		5,538.2	5,469.0	11,007.2
Total suitable for Swainson's hawk		4,005.6	5,015.7	9,021.3

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Table 2-6. Compensation Acreage Required for Losses of Swainson's Hawk Foraging Habitat on the DW Habitat and Reservoir Islands

Island	Suitable Acres Lost	Compensation Ratio	Compensation Acreage
Bacon	4,005.6	10% X 1.00	400.6
		90% X .75	2,703.8
		Bacon total	3,104.4
Webb	5,015.7	30% X .75	1,128.5
		70% X .50	1,755.5
		Webb total	2,884.0
Bouldin	986.1	80% X .75	591.7
		20% X .50	98.6
		Bouldin total	690.3
Holland	40.8	90% X .75	27.5
		10% X .50	2.1
		Holland total	29.6
		Total	6,708.3

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Table 2-7. Swainson's Hawk Foraging Habitat Types That Will Be Available on the DW Habitat Islands with Implementation of the HMP

Habitat Type[a]	Bouldin Island	Holland Tract	Total Acres
Corn/wheat	1,629	955	2,584
Small grains	106	152	258
Mixed agriculture/seasonal wetland	1,014	631	1,645
Seasonal managed wetland	1,723	393	2,116
Pasture/hay	132	72	204
Herbaceous upland	479	253	732
Total	5,083	2,456	7,539

[a] Emergent marshes, seasonal ponds, and riparian woodland and scrub habitats, which do not provide foraging habitat values for Swainson's hawks, will also be developed on habitat islands.

Table 2-8. Management Strategies for Swainson's Hawk on the DW Habitat Islands

Management Goal	Management Objectives	Habitat Management Strategies
1. Provide suitable foraging habitat for summer populations.	A. Develop and manage pastures and herbaceous upland habitats specifically to provide foraging habitat.	1. Portions of pastures and herbaceous uplands should be mowed as needed to maintain open areas to allow accessibility to prey. Unmowed areas will continue to provide escape cover for voles and other prey species.
	B. Manage corn/wheat rotation, small grain, mixed agriculture/seasonal wetland, and seasonal managed wetland habitats to provide foraging habitat during periods when fields are not flooded.	2. Flooding of pastures to provide waterfowl habitat should be deferred (except during summer irrigation periods) until summer Swainson's hawk populations have migrated from the Delta. 3. Corn/wheat rotation fields should be harvested in a manner that provides open strips between unharvested rows of corn to allow accessibility to prey. Fall flooding of corn and wheat fields is expected to concentrate voles and other prey species as fields are flooded. Flooding should be staggered between fields to provide high prey concentrations over a longer period. 4. Small grain fields should be completely harvested after July 15 and should not be flooded. 5. Portions of seasonal managed wetland and mixed agriculture/seasonal wetland should be mowed as needed to maintain open areas to allow accessibility to prey. Unmowed areas will continue to provide escape cover for voles and other prey species. Unflooded upland border strips should be maintained around wetlands to provide escape cover for voles during flood periods and to maintain vole populations of sufficient size to ensure repopulation of wetlands during dry periods. 6. When feasible, the use of pesticides or herbicides known to affect nesting success should be avoided.
2. Provide foraging habitat for wintering populations.	A. Develop and manage herbaceous upland habitats specifically to provide foraging areas.	1. Portions of herbaceous uplands should be mowed during the growing season to maintain open areas to allow accessibility to prey. 2. Upland herbaceous habitats should not be flooded. Relatively high prey densities should be available in upland strips adjacent to flooded habitats because these areas will provide escape cover for voles during flood periods.

Management Goal	Management Objectives	Habitat Management Strategies
3. Provide suitable nesting habitat.	A. Establish and maintain riparian habitats that support suitable nesting trees.	1. Encourage establishment of cottonwood and willow trees in riparian forest habitats.
	B. Protect stands of existing trees.	2. Discourage types of human disturbance known to cause nest abandonment in the vicinity of nest sites.

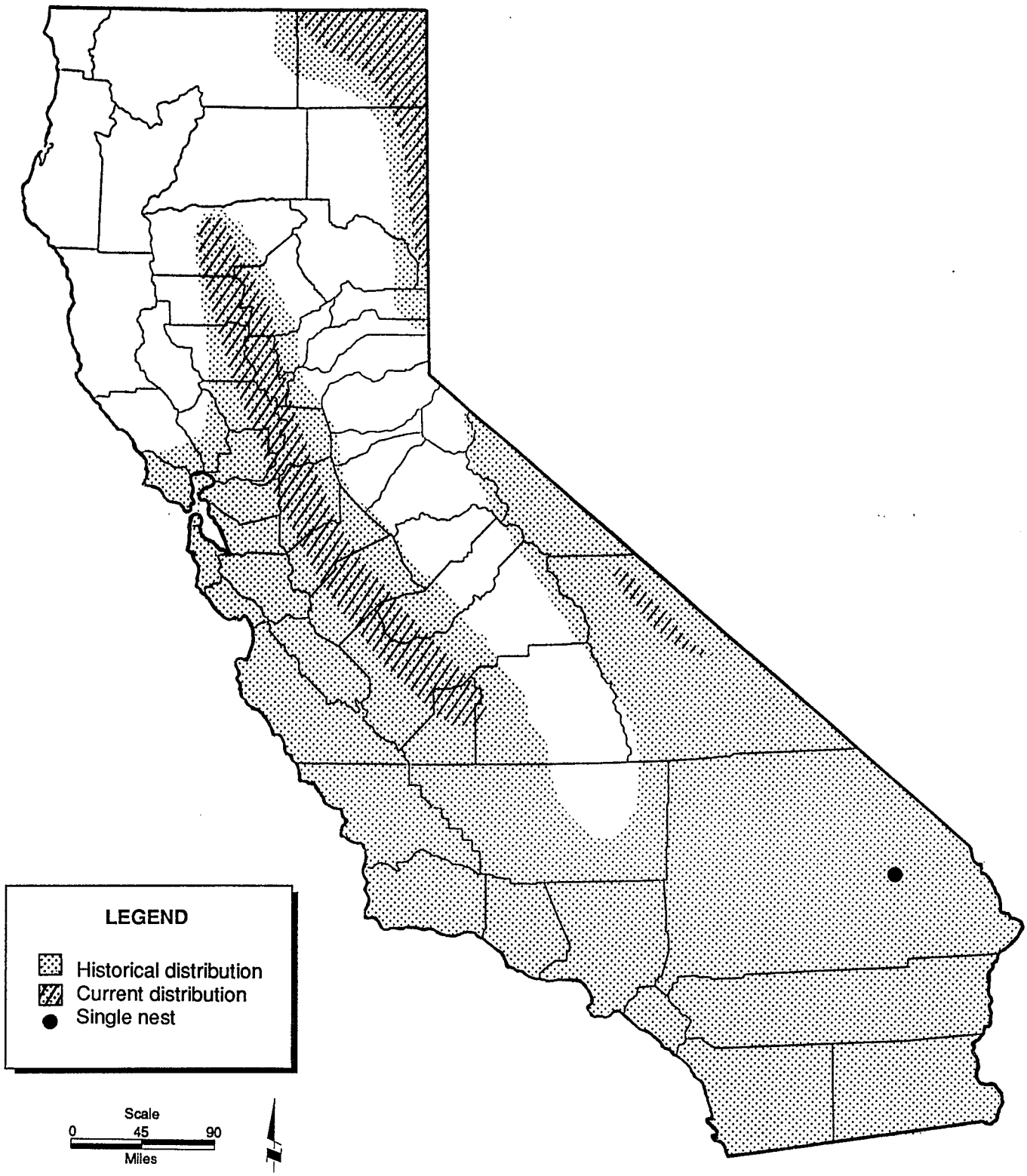

Figure 2-1.
Historical and Current Distribution of the Swainson's Hawk in California

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Prepared by: Jones & Stokes Associates

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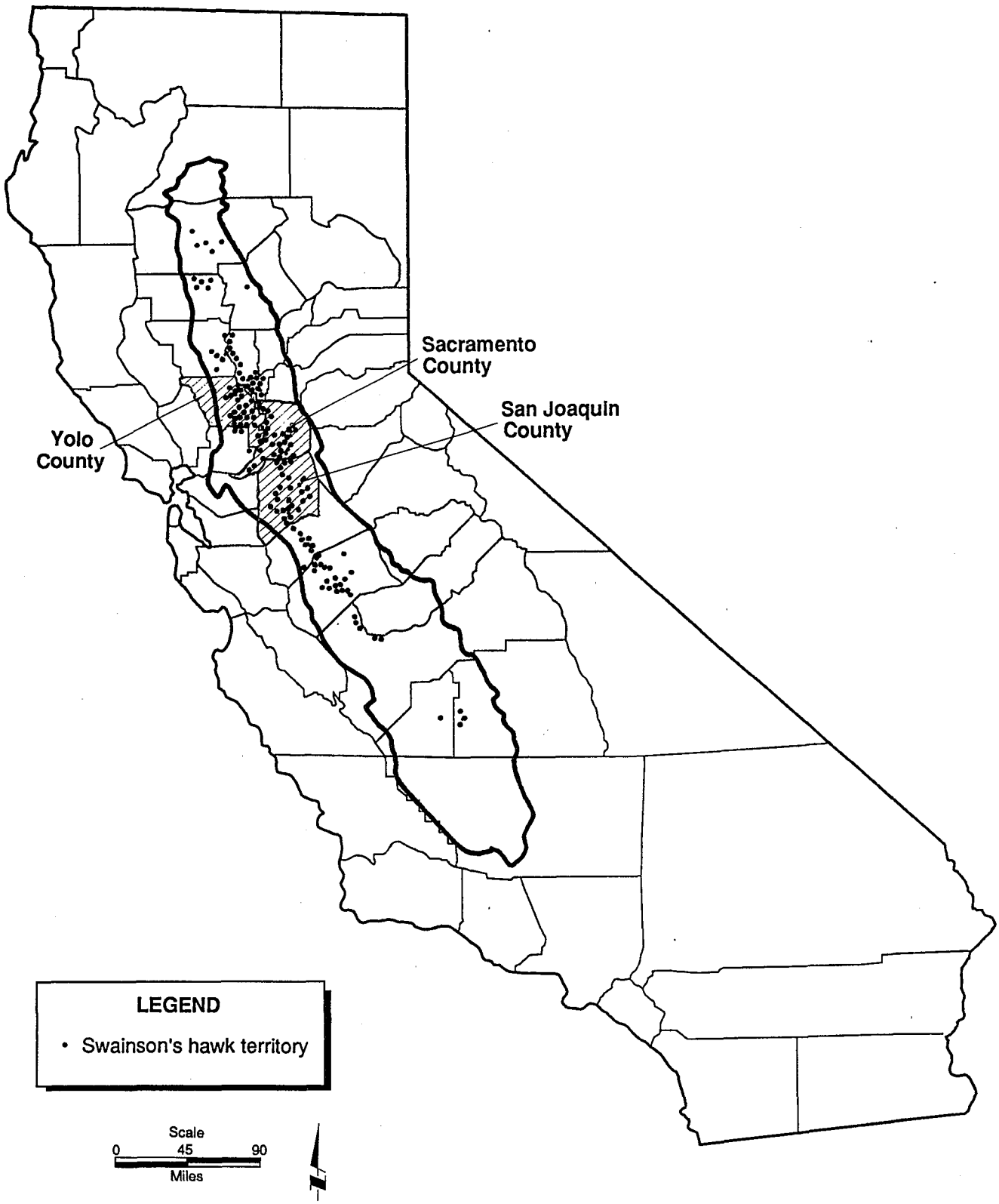

Figure 2-2.
Distribution of the Swainson's Hawk in the Central Valley of California in 1988

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Prepared by: Jones & Stokes Associates

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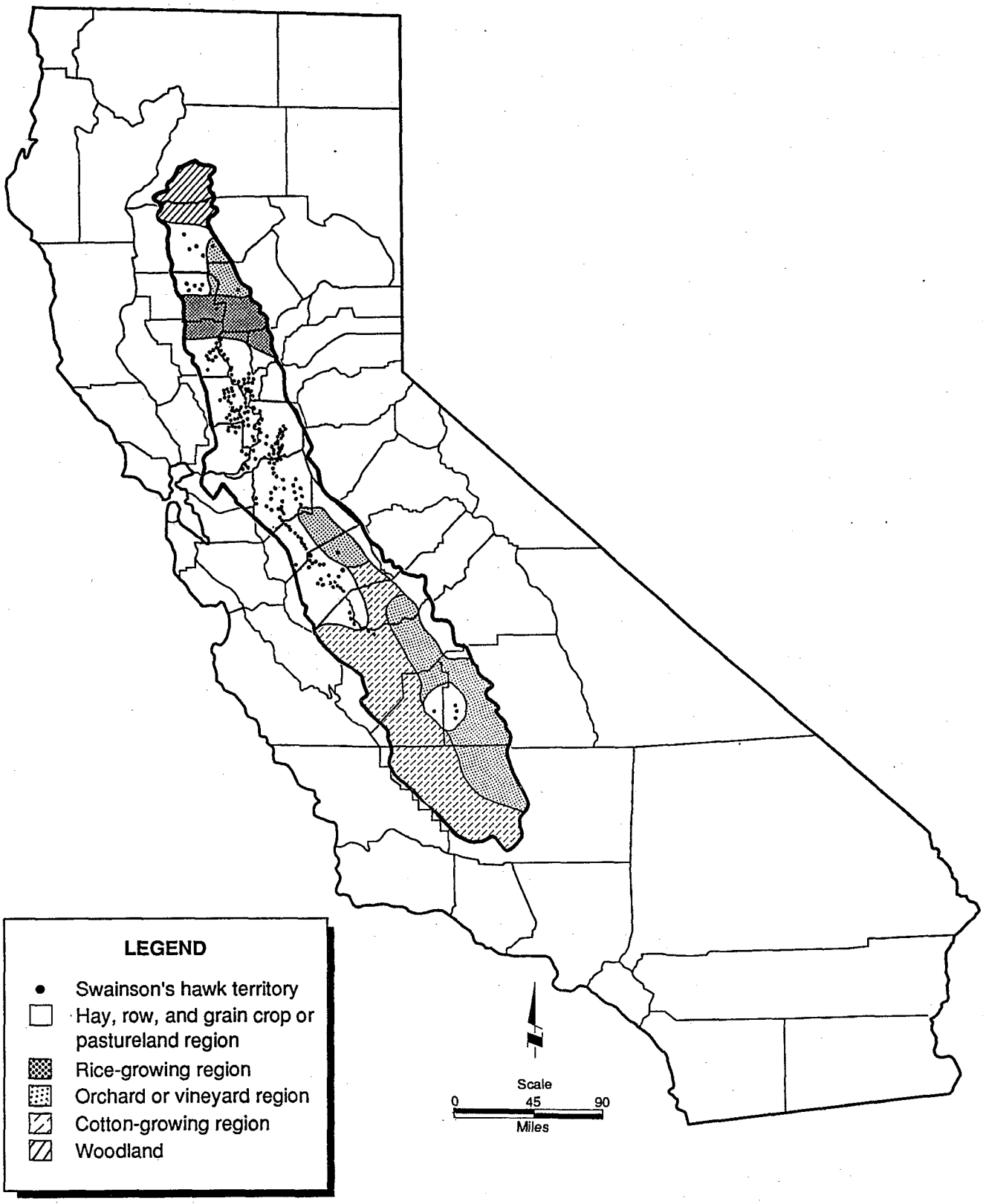

Figure 2-3.
Distribution of the Swainson's Hawk in the Central Valley of California in Relation to Generalized Cropping Patterns

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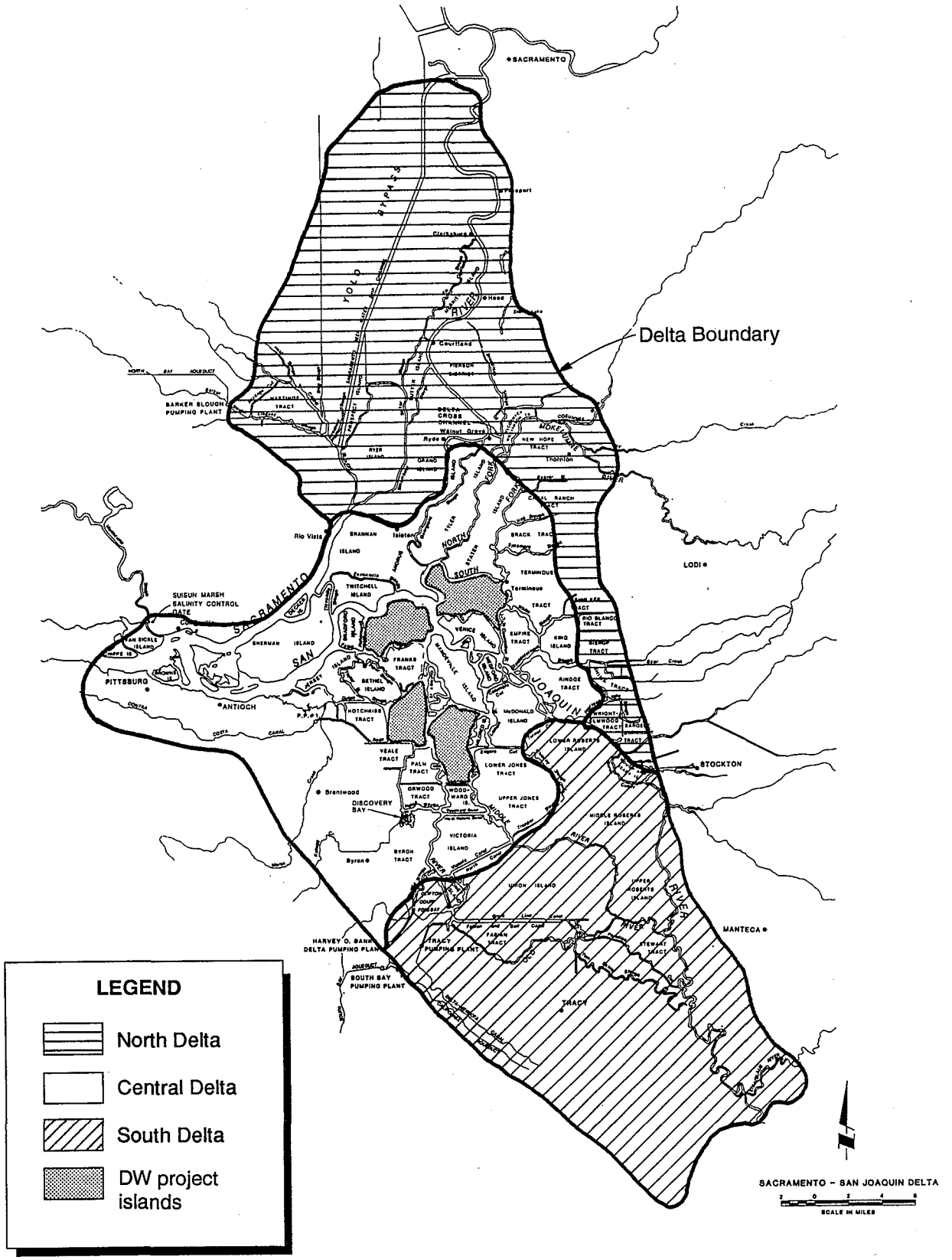

Figure 2-4.
Locations of the North, Central, and South Delta Regions Based on Generalized Cropping Patterns

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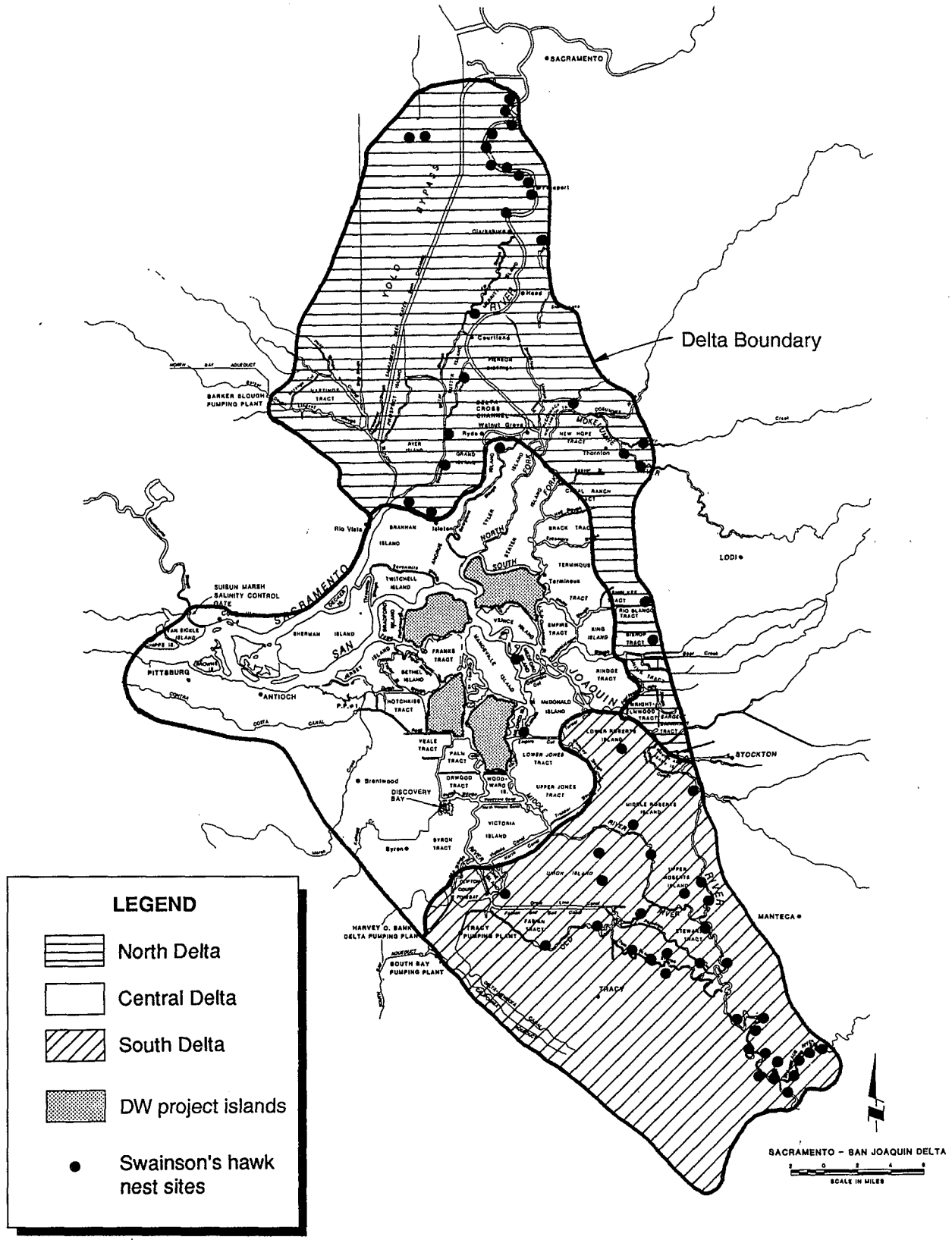

Figure 2-5.
Distributions of Swainson's Hawk Nest Sites in the Delta in 1990

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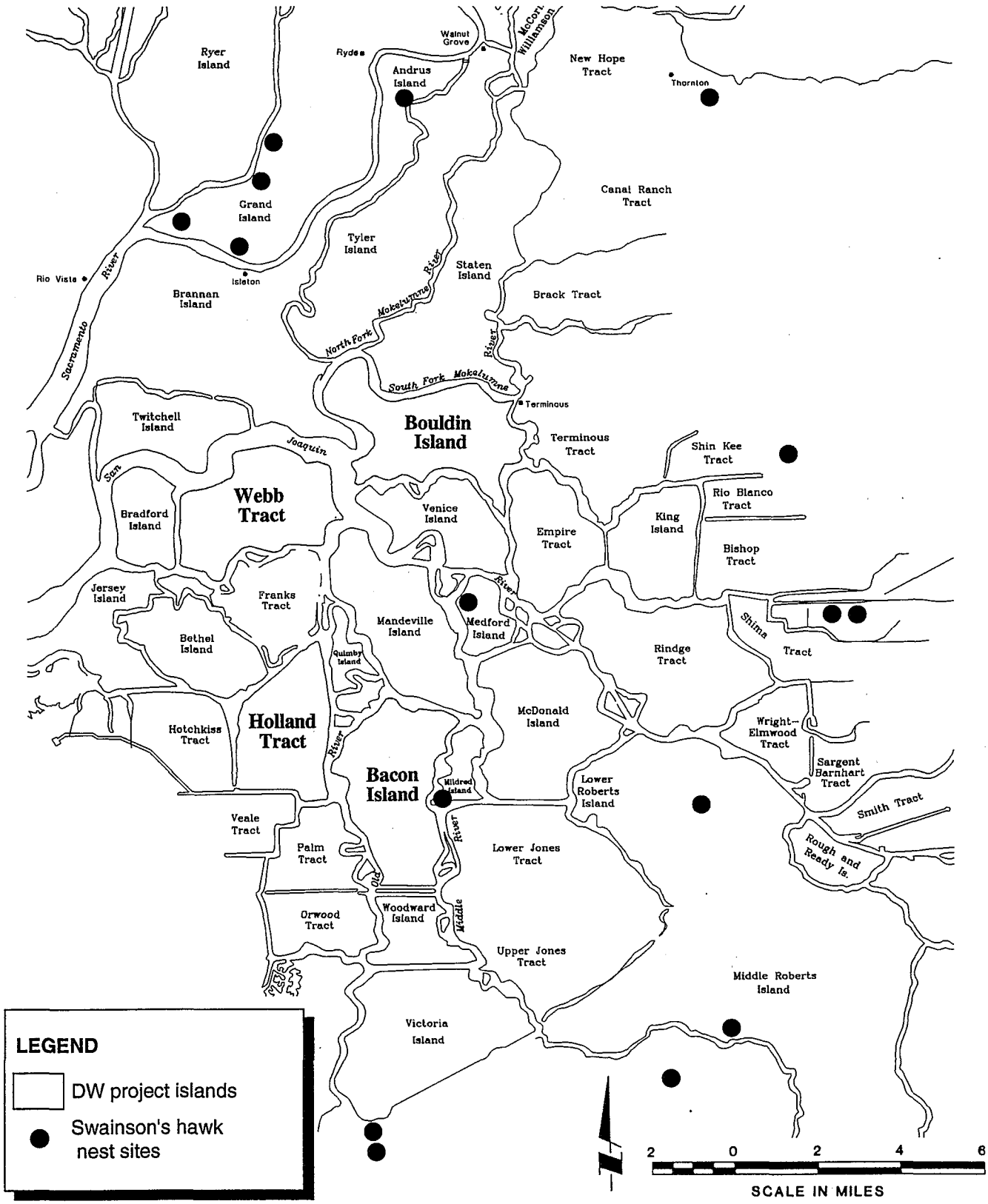

Figure 2-6.
Locations of Swainson's Hawk Nest Sites within 10 Miles of the DW Project Islands

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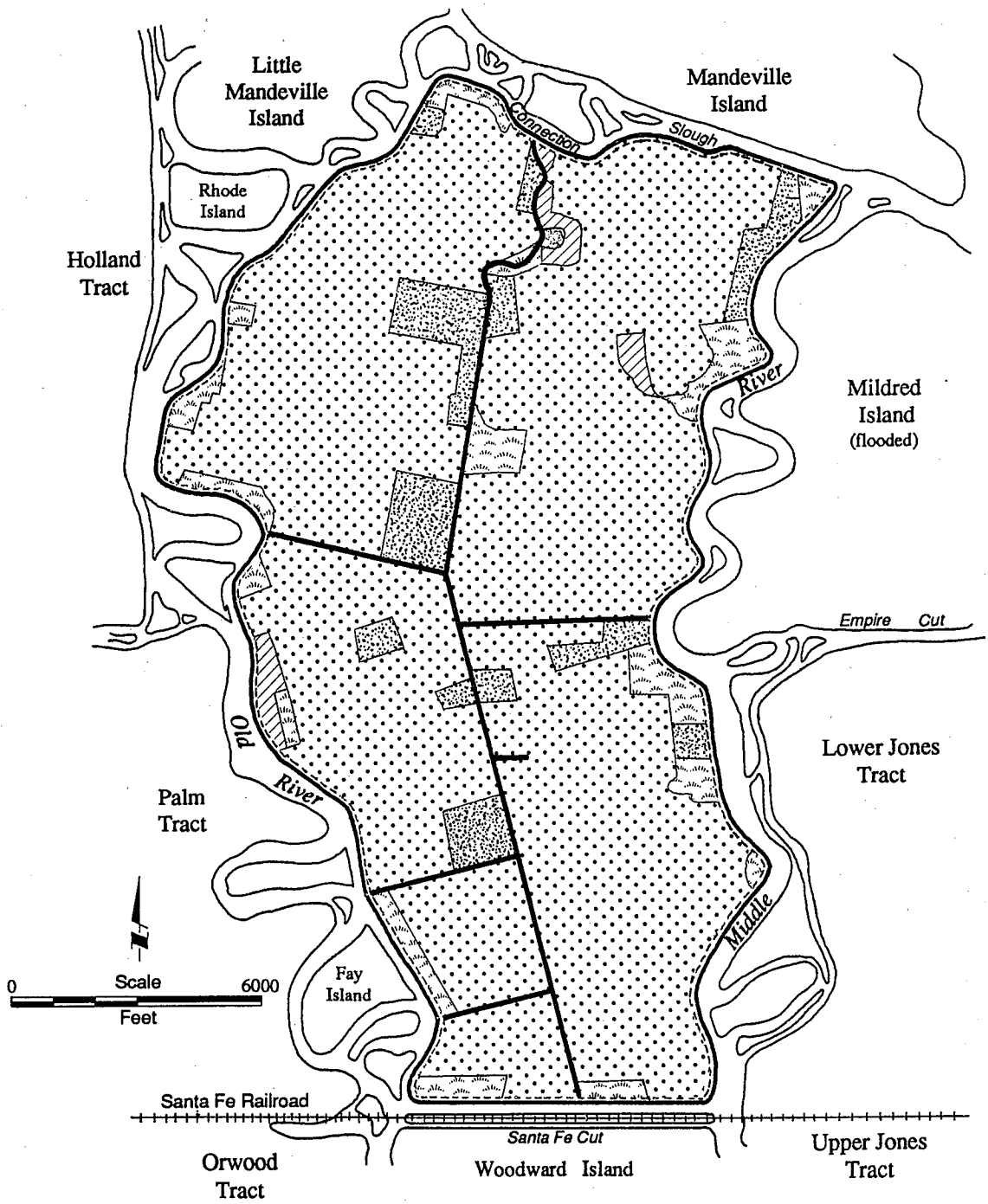

Note: Habitat types are based on habitat mapping conducted by Jones & Stokes Associates in December 1987.

Figure 2-7.
Existing Bacon Island Habitat Types

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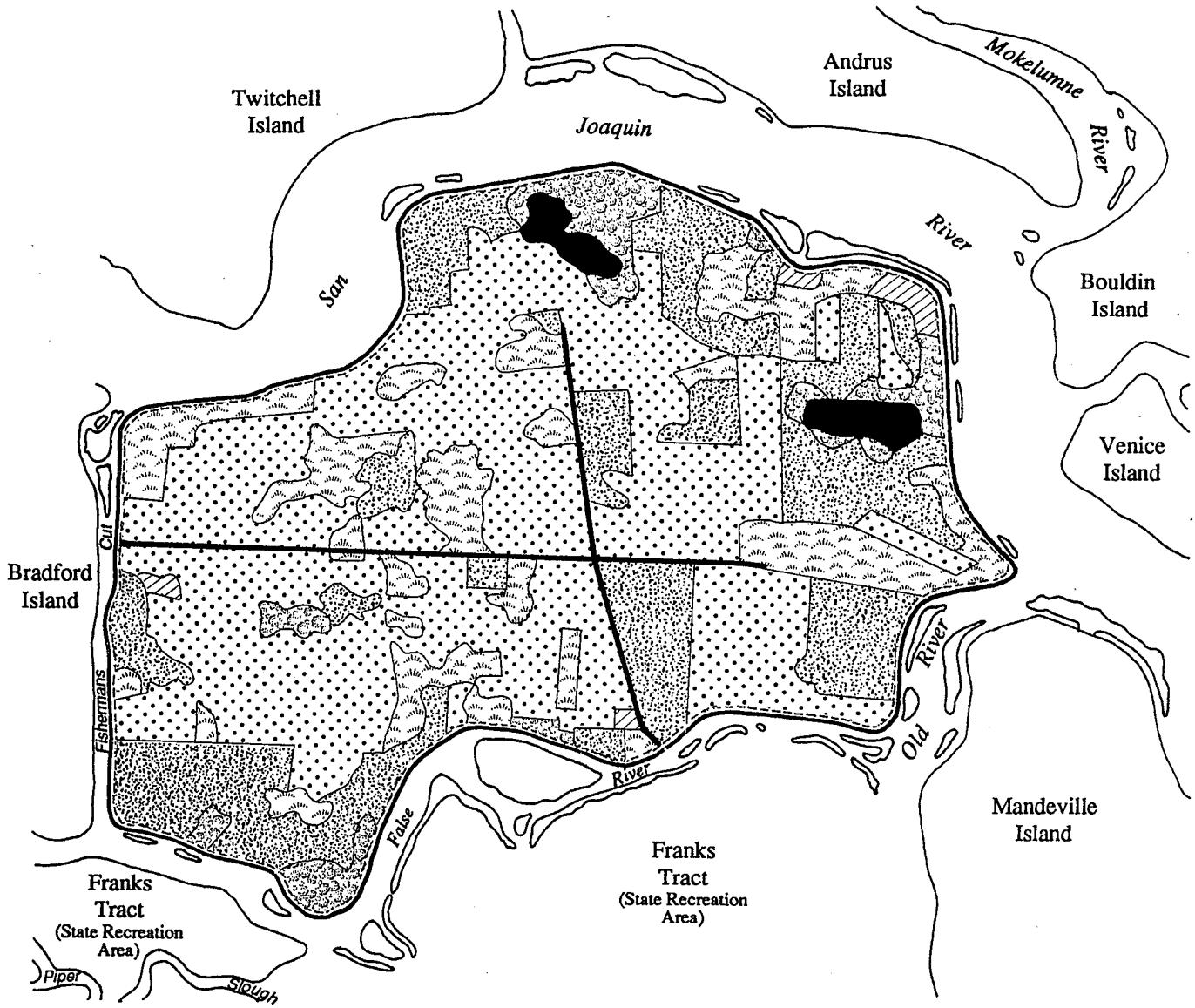

Note: Habitat types are based on habitat mapping conducted by Jones & Stokes Associates in December 1987.

Figure 2-8.
Existing Webb Tract Habitat Types

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Prepared by: Jones & Stokes Associates

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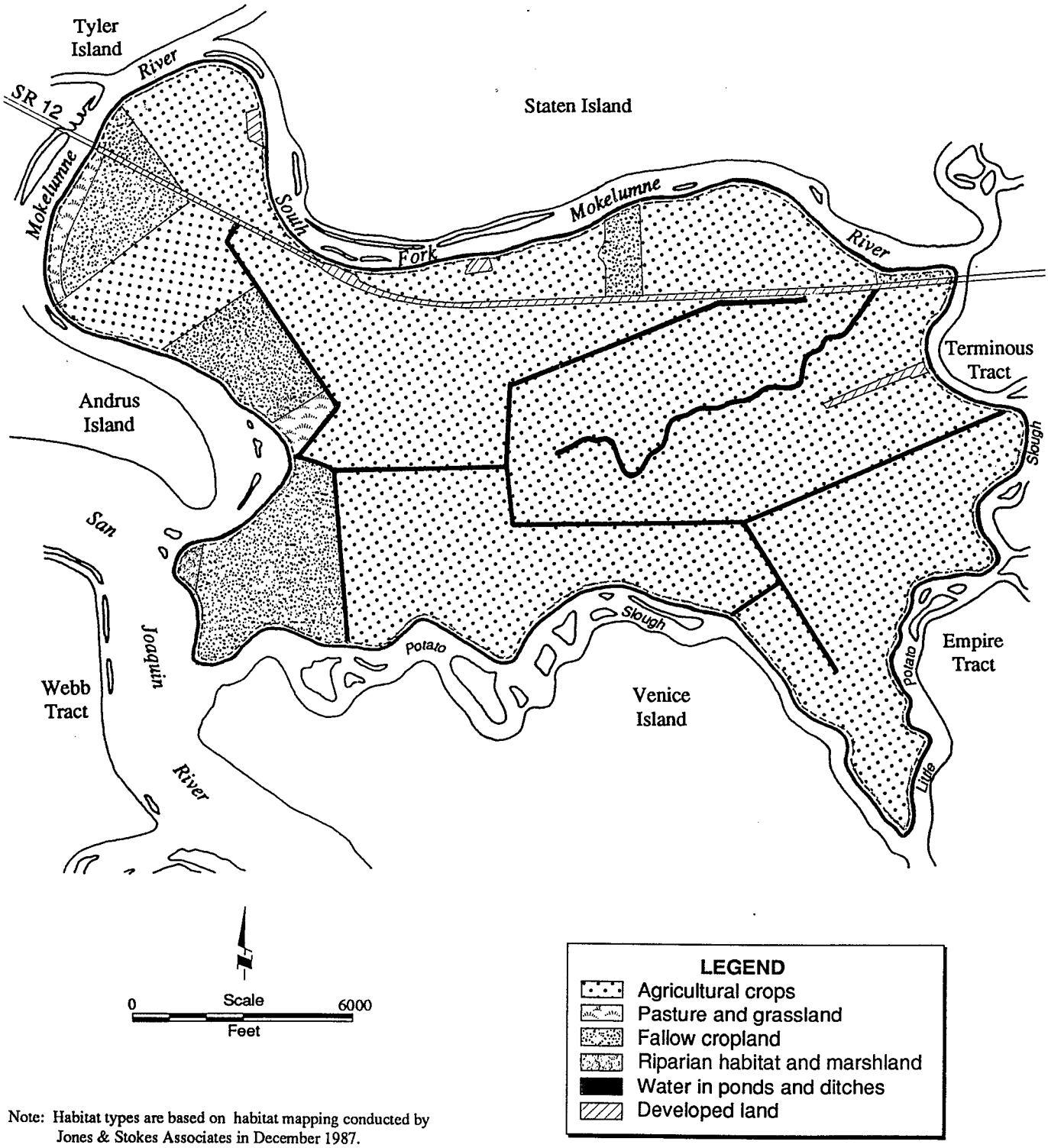

Note: Habitat types are based on habitat mapping conducted by Jones & Stokes Associates in December 1987.

Figure 2-9.
Existing Bouldin Island Habitat Types

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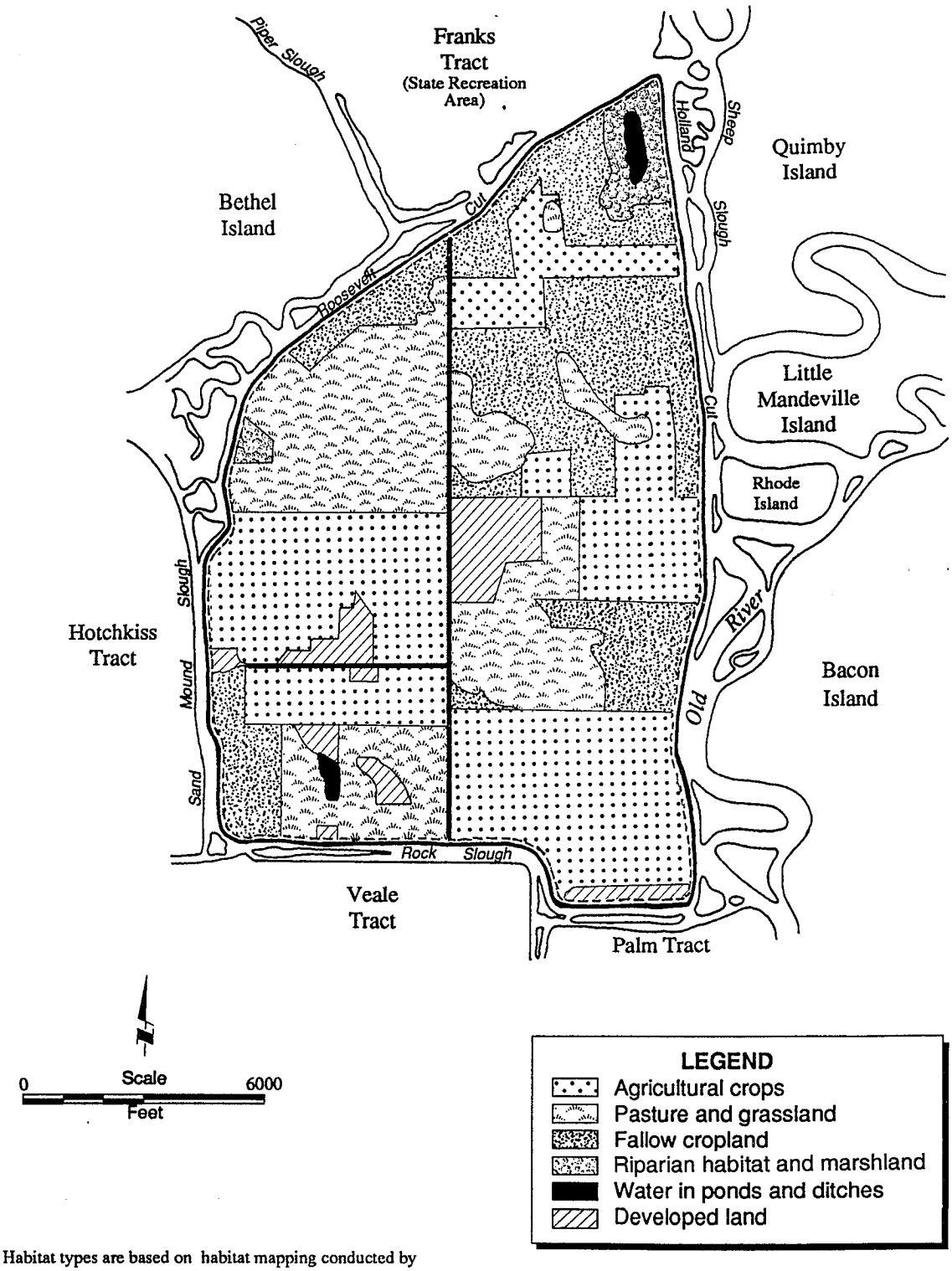

Note: Habitat types are based on habitat mapping conducted by Jones & Stokes Associates in December 1987.

Figure 2-10.
Existing Holland Tract Habitat Types

DELTA WETLANDS PROJECT
Prepared by: Jones & Stokes Associates

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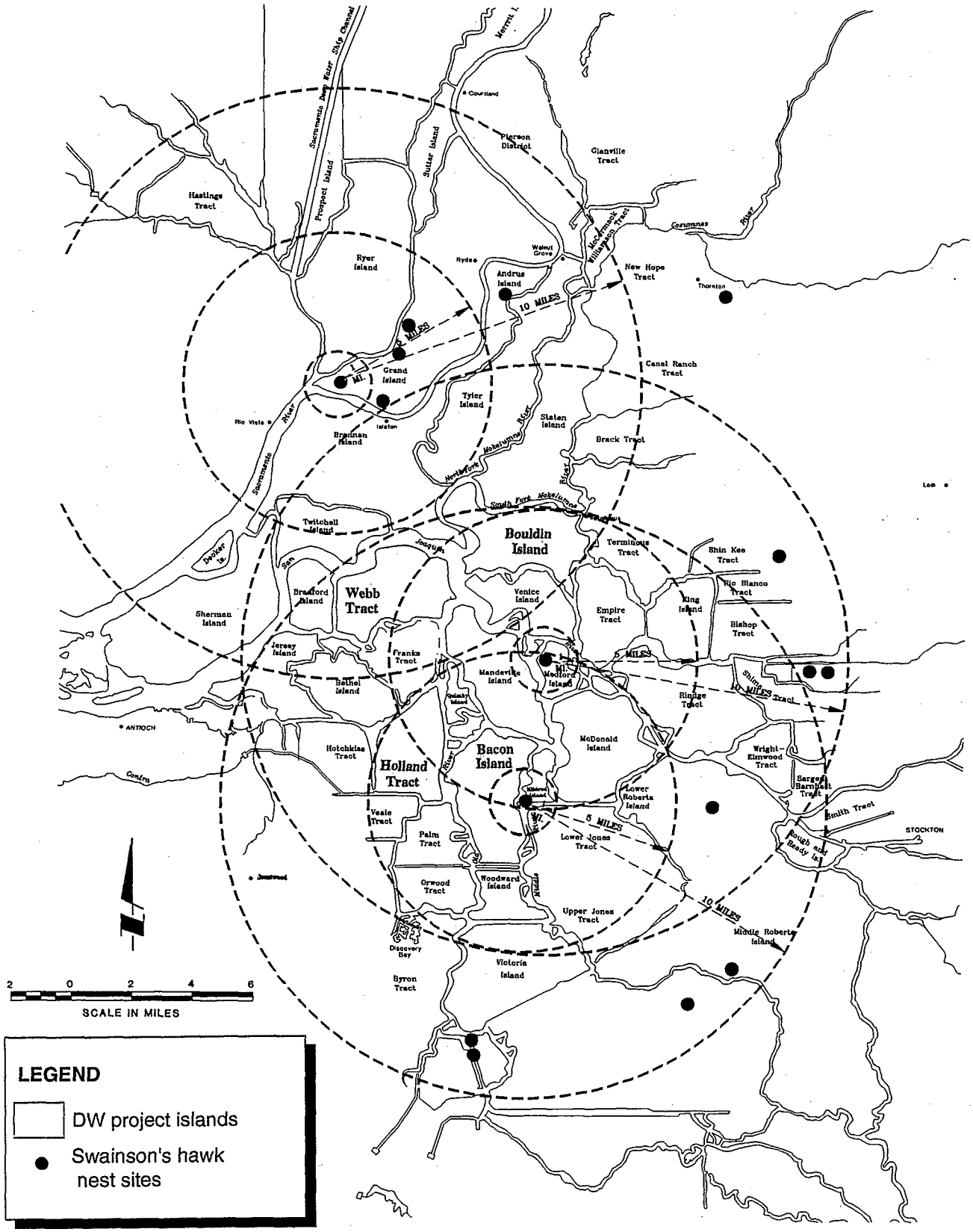

Figure 2-11.
Coverage of the DW Project Islands by 1-, 5-, and 10-Mile Radius Areas around Selected Swainson's Hawk Nest Sites That Area within 10 Miles of the Project Area

DELTA WETLANDS PROJECT
Prepared by: Jones & Stokes Associates

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Section 3. Analysis of Impacts of the Delta Wetlands Project on the Greater Sandhill Crane

SPECIES DESCRIPTION

The greater sandhill crane is the largest of four recognized subspecies of sandhill crane (Walkinshaw 1949). The greater sandhill crane is a wetland-associated bird, requiring marsh and meadow habitats during the breeding season and shallow, wet habitats for roosting during winter. This subspecies feeds primarily on invertebrates, roots, tubers, and certain cereal grains during winter (Schlorff and Bloom 1983).

Four populations of greater sandhill crane are recognized: Eastern, Rocky Mountain, Lower Colorado River Valley, and Central Valley. The Central Valley population nests from northeastern California to British Colombia (USFWS 1978, Pogson and Lindstedt 1988). The entire Central Valley population, estimated at 3,400-6,000 individuals (DFG 1989), winters in the Central Valley, along with the entire Pacific Flyway population of lesser sandhill crane (*Grus canadensis canadensis*) (Pogson and Lindstedt 1988).

Seven locations in the Central Valley are considered important wintering sites for the greater sandhill crane: the Delta, Chico, Butte Sink, Angel Slough, Modesto, Merced, and Pixley (Figure 3-1). The most important of these sites is the Delta, which supports as much as 75% of the Central Valley population during late winter (Pogson and Lindstedt 1988).

Winter Habitat Requirements

Both roosting and foraging habitat are essential to the Central Valley population during winter. Greater sandhill cranes congregate in communal roosts at night and fly off each morning to forage in suitable fields, pastures, or other shallow wetland habitats. Most traditional foraging areas are near (within 2-3 miles of) communal roost sites. Thus, the proximity of foraging habitat to communal roost sites is an important determinant of suitable wintering habitat.

Communal roost sites are typically large fields (100+ acres), flooded with 2-25 cm of standing or slowly moving water, and with relatively low-relief shorelines (Pogson and Lindstedt 1988). Most roost sites in the Central Valley are on private duck clubs and have been created to attract wintering waterfowl.

Foraging habitat for the Central Valley population varies at different locations in the Central Valley. The primary source of carbohydrates is cereal grains: waste corn in the Delta and Modesto regions and waste rice in the Sacramento Valley. Cranes also forage on wheat sprouts in newly planted winter wheat fields and on sprouts, shoots, tubers, invertebrates, and seeds in fallow fields and in uncultivated habitats (field borders, levees, canal and irrigation ditch banks). (Pogson and Lindstedt 1988.)

Reasons for Decline and Threats to the Population

The decline in the breeding population in California is attributable primarily to the loss and degradation of important wetland breeding sites in northeastern California (DFG 1989). Conversion of native meadows and marshes to agriculture, mowing of meadow grasses during the breeding season, and damage to meadow habitats and active nests resulting from cattle grazing have contributed to the population decline in the state.

The conversion of wetland habitats in the Central Valley may also have contributed to population declines by eliminating important wintering habitat. Pogson and Lindstedt (1988) suggest that the distribution of wintering cranes may have been more widespread throughout the Central Valley, but destruction of wetland habitats caused the Central Valley population to concentrate onto the several remaining key winter sites.

Management activities to prevent further population declines in the state include acquiring important breeding sites in northeastern California (e.g., DFG acquisition of Ash Creek Wildlife Area) and key roosting sites in the

Central Valley (e.g., Woodbridge Ecological Reserve). Other activities include working with landowners to continue to maintain wetland habitats on private lands in key wintering habitat areas (DFG 1989).

STATUS OF THE GREATER SANDHILL CRANE IN THE SACRAMENTO-SAN JOAQUIN DELTA

Distribution and Abundance

Greater sandhill cranes begin arriving in the Central Valley in October. During winter, the distribution of the Central Valley population shifts as cranes move between the major wintering sites. Records from Pogson and Lindstedt (1988) and DFG crane surveys indicate that populations in the Delta are relatively small in October (from zero to about 1,500 cranes) and begin increasing in mid-November to late November. The Delta population peaks in January and February (4,000-5,000 cranes) and declines sharply by March as cranes begin their northward migration.

The increased abundance of cranes in the Delta during January and February coincides with a decline in abundance in the Chico and Butte sink areas. Pogson and Lindstedt (1988) suggest that movement of the population from the northern Sacramento Valley to the Delta may be a traditional occurrence, possibly brought on by changes in food resources or roosting habitat availability. Thus, although greater sandhill cranes winter in the Delta from October through March, their abundance in the Delta is greatest toward the latter portion of the wintering season.

The central Delta and the Cosumnes and Mokelumne River floodplains provide habitat for the entire Delta wintering population (Pogson and Lindstedt 1988). For this analysis, the Cosumnes and Mokelumne River floodplains east of Interstate 5 are also included in the Delta region (Figure 3-2). Delta islands considered important greater sandhill crane winter foraging and roosting habitat include Staten Island, Tyler Island, Brack Tract, and Canal Ranch. Other Delta islands considered crane winter foraging areas include Grand Island, Terminous Tract, New Hope Tract, and Bouldin Island (Pogson and Lindstedt 1988). Isolated records of cranes suggest that cranes may also forage on adjacent Delta islands occasionally. DFG has recently expanded the area in the Delta designated by Pogson and Lindstedt (1988) as a greater sandhill crane wintering area. This expansion is based on crane sightings made during waterfowl survey flights, fowl cholera monitoring, and routine environmental review and wildlife management activities from 1983 to 1993 (Wernette pers. comm.).

Cranes are found primarily in suitable roosting habitat and adjacent suitable foraging areas. Roost sites are limited in the central Delta, although cornfields and wheat fields and other crane foraging habitats are abundant. Thousands of lesser and greater sandhill cranes converge each evening on the few available roost sites in the Delta provided by private duck clubs. Two important roost sites, Woodbridge Ecological Reserve and the Robin Bell property, are owned by DFG solely for the management of greater sandhill cranes. Thus, although suitable winter foraging habitat is abundant in the Delta, only a small portion near roost sites is regularly used by cranes.

Use of the Delta Wetlands Project Islands by Greater Sandhill Cranes

Information presented in this section is based on surveys prepared in 1987-1990. No change has occurred since that time regarding circumstances on the DW islands or land use management decisions; therefore, this information generally reflects current conditions on the DW islands unless otherwise noted.

Bouldin Island

Greater sandhill cranes were regularly observed on Bouldin Island in surveys conducted between October 1987 and March 1988; the frequency of use apparently increased from November through February and declined sharply by March as cranes began their northward migration toward their breeding grounds. This pattern corresponds with DFG counts of sandhill cranes on Bouldin Island made between 1983 and 1989 (Table 3-1) and with the overall increase in abundance of greater sandhill cranes in the Delta during December and January noted by Pogson and Lindstedt (1988). Comparison of monthly greater sandhill crane populations at Bouldin Island with estimates for the entire Delta (Pogson and Lindstedt 1988) indicate that Bouldin Island supports an estimated 0.8%-5.0% of the monthly crane population in the Delta during November to January.

Cranes were observed feeding in harvested cornfields and winter wheat, and on herbaceous habitats on levee slopes on Bouldin Island in 1988. Bouldin Island supported 5,625 acres of suitable crane foraging habitat, mostly under intensive agriculture in 1987. The nearest important winter foraging areas are the adjacent Staten

and Tyler Islands to the north and Brack Tract to the northeast, which support up to 4,000 wintering cranes (Pogson and Lindstedt 1988).

Bouldin Island is the only DW project island that receives substantial use by wintering greater sandhill cranes or that is within the area designated as a crane wintering area by Pogson and Lindstedt (1988). DFG has recently designated all of Bouldin Island as a greater sandhill crane wintering area based on additional sightings through 1993.

Webb Tract

One sandhill crane (subspecies not identified) was observed on Webb Tract during an aerial survey in December 1987; no other cranes were seen here during aerial and ground surveys during this period. A flock of nine cranes (subspecies also not identified) was also seen on an incidental visit to Webb Tract on January 19, 1991. Although Webb Tract was not considered an important greater sandhill crane wintering area by Pogson and Lindstedt (1988), it supports suitable foraging habitat (e.g., nearly 2,700 acres of corn and wheat and more than 800 acres of herbaceous upland habitat in 1987) and is only about 3 miles from important roost sites on Tyler and Staten Islands. DFG has recently designated Webb Tract as a greater sandhill crane wintering area based on additional sightings through 1993.

Bacon Island

Most crops on Bacon Island are not suitable as foraging habitat for greater sandhill cranes. Cranes have not traditionally used Bacon Island, and none were observed during surveys of the island in 1987 and 1988. DFG, however, reports a recent isolated record of a greater sandhill crane on Bacon Island (Wernette pers. comm.). Bacon Island is approximately 8 miles from important greater sandhill crane wintering areas (Pogson and Lindstedt 1988).

Holland Tract

No cranes were observed on Holland Tract during field surveys. The only record of greater sandhill crane use of Holland Tract found was a recent isolated record reported by DFG. Holland Tract is approximately 7 miles from the nearest important greater sandhill crane wintering areas (Pogson and Lindstedt 1988). Although portions of the island provide suitable foraging habitat, the island is not expected to support regular use by greater sandhill cranes because of the distance to important wintering areas.

IMPACT OF THE PROJECT ON GREATER SANDHILL CRANES

Suitable wintering habitat in the Delta is confined to a small, clearly identifiable region of the central Delta. Therefore, the loss of traditional wintering sites from this area could adversely affect the Central Valley population.

Methods

There are no established mechanisms or guidelines for assessing or mitigating impacts on the greater sandhill crane. DFG recommends a conservative mitigation approach using an acre-for-acre compensation ratio for all lands known to be used by the greater sandhill crane, including lands with only isolated records of crane use (Wernette pers. comm.). The rationale for this is DFG's interpretation of the California Endangered Species Act and the determination that loss of any suitable foraging habitat for wintering cranes may affect the species. Although surveys indicated that only Bouldin Island receives substantial use by cranes, this assessment uses the DFG recommendation for assessment and mitigation.

DFG further recommends that impacts on greater sandhill cranes in the south Delta (i.e., Bacon Island) be mitigated in the south Delta (i.e., Holland Tract) and that impacts in the north Delta (i.e., Webb Tract) be mitigated in the north Delta (i.e., Bouldin Island).

Results

Small numbers of greater sandhill cranes make irregular use of the DW reservoir islands; therefore, the DW project is expected to have a negligible impact on current crane use patterns in the Delta. However, the development of the reservoir islands (Bacon Island and Webb Tract) would remove 1,751 acres of potential crane habitat in the south Delta (Bacon Island) and 4,850 acres of potential crane habitat in the north Delta (Webb Tract) (Table 3-2).

Additional crane habitat would be lost on Bouldin Island and Holland Tract as a result of implementation of the comprehensive HMP that includes compensating on the habitat islands for losses of wetland habitats (i.e.,

riparian forest, riparian scrub, and pond) on the reservoir islands. A total of 418 acres on Bouldin Island would be used to compensate for losses of wetland habitats on Webb Tract, and a total of 9 acres on Holland Tract would be used to compensate for losses on Bacon Island (Table 3-3).

A total of 7,028 acres is required to mitigate all loss of greater sandhill crane foraging habitat (Table 3-3).

An additional feature of the project is the management of a waterfowl hunting program on the habitat islands during winter. Because cranes are known to be sensitive to hunting and other human disturbances, the hunting program could have the effect of forcing cranes off the islands during hunt times or preventing cranes from establishing traditional foraging use patterns. Therefore, in addition to offsetting foraging habitat acreages, greater sandhill crane protection measures would also ensure that cranes will use the habitat islands within the framework of a hunting program. Therefore, to fully offset impacts of foraging habitat loss, a minimum of 14% of the habitat islands would be closed to hunting disturbances on the habitat islands.

Mitigation

DW would use habitat island sites to offset greater sandhill crane impacts of the DW project. A minimum of 7,028 acres is required to be managed during fall and winter as high-quality habitat for the greater sandhill crane to compensate for project impacts. Implementation of the HMP, however, would provide 7,673 acres of suitable crane habitat.

Under the HMP, a total of 10 habitat types would be developed on each island, seven of which are suitable for greater sandhill crane habitat (Table 3-4). Although some habitats would be co-managed for waterfowl, they will be managed in a manner to provide moderate to high crane foraging values. In addition, the proposed juxtaposition of seasonal managed wetland, corn-wheat rotation, uplands, and pasture habitats would provide extensive potential crane roosting habitat adjacent to crane foraging habitat.

To offset the potential effect of the hunting program on the habitat islands, three no-hunting zones (closed zones) would initially be established. The sizes, locations, and habitat juxtapositions of the closed zones were based on mitigation requirements for cranes and waterfowl. Thus, the sizes of closed zones established in the HMP exceeds the minimum mitigation requirement for cranes.

Two closed zones, totaling 1,279 acres (21% of Bouldin Island), are proposed for Bouldin Island, and one closed zone, totaling 728 acres (24% of Holland Tract), is proposed for Holland Tract. Crane roosting habitat, as described above, has been incorporated into the closed-zone areas. In addition, some mixed agriculture/seasonal wetland habitat type is also included within each closed zone to evaluate crane use of this experimental habitat type. The types of human disturbances in and adjacent to closed zones would also be restricted. Use of the airstrip located in the east Bouldin Island closed zone also would be restricted. All flights related to habitat management activities would be restricted to nonhunt days to reduce disturbance. Flights related to recreation may occur on hunt days, but landings and takeoffs may only occur between 12:00 p.m. and 2:00 p.m. DW will monitor the effects of airstrip use on greater sandhill cranes to determine whether existing use restrictions are sufficient to satisfy mitigation requirements.

Crane use of hunted portions of the islands will be influenced by the density of hunters and the level and frequency of disturbance. Hunt days will occur on Wednesdays, Saturdays, and Sundays. Free-roam and spaced-blind hunting areas have been established on both habitat islands in a ratio of approximately 50:50. Hunter density will not exceed one hunter per 60 acres in the free-roam zone and one blind per 50 acres in the spaced-blind zone. The spaced-blind zones have been designed to surround the closed zones to limit hunter movement and disturbances near the closed zones. Fixed spaced blinds will be at least 200 feet from the closed-zone boundaries. The free-roam hunting areas have been established in the remaining portions of the habitat islands. Potential crane use of hunted areas is unknown; however, it is anticipated that hunted areas will receive limited crane use during nonhunt days and infrequent incidental use during hunt days.

Table 3-5 outlines management objectives and specific strategies for managing the habitat islands as suitable habitat for greater sandhill cranes.

Conclusions

Impacts of the DW project on the greater sandhill crane are assessed using DFG's recommendation of an acre-for-acre compensation ratio. Using this approach, the proposed project would replace 7,028 acres of potential crane foraging habitat on Bacon Island and Webb

Tract with a minimum of 7,028 acres of suitable habitat on Bouldin Island and Holland Tract (7,673 acres of suitable crane habitat will be provided under the HMP. The typical cropping pattern of corn and wheat on the habitat islands would be converted to a mosaic of 10 habitat types, seven of which are suitable greater sandhill crane habitat. Management of these cover types (corn/ wheat, wheat, managed agriculture-wetland, seasonal managed wetland, pasture, upland, and summer seasonal pond) during fall and winter would maximize crane foraging and roosting habitat suitability. Establishment of closed zones will ensure that approximately 22% of the habitat islands would be free of hunting and other disturbances.

Implementation on the habitat islands of the HMP and of mitigation measures identified in the EIR/EIS would offset adverse impacts resulting from habitat loss on reservoir islands and reduce impacts on greater sandhill cranes to a level of less than significant. Overall, the DW project would have a substantial beneficial impact on the greater sandhill crane by enhancing foraging and roosting habitat conditions in the north and south Delta regions.

Table 3-1. Sandhill Cranes Observed on Bouldin Island during Aerial Surveys Conducted by DFG between 1983 and 1989

Date of Survey	Number of Sandhill Cranes
October 1986	0
November 1986	0
November 1985	3
November 1983	115
November 1983	117
December 1985	65
December 1985	79
January 1989	318
January 1987	250
January 1986	250
March 1987	0

C-062401

Table 3-2. Acreages of Suitable Greater Sandhill Crane Habitat Types on the DW Reservoir Islands

Habitat	Suitable for Sandhill Crane	Bacon Island	Webb Tract	Total
Riparian woodland		0.0	47.7	47.7
Riparian scrub		3.4	58.0	61.4
Emergent marsh		2.7	172.0	174.7
Exotic marsh	X	30.4	783.3	813.7
Annual grassland	X	260.8	534.6	795.4
Exotic perennial grassland	X	267.6	304.2	571.8
Corn	X	775.8	2,222.9	2,998.7
Wheat	X	0.0	445.0	445.0
Milo	X	83.6	0.0	83.6
Potato		1,882.6	0.0	1,882.6
Sunflower		190.7	0.0	190.7
Asparagus		1,069.1	0.0	1,069.1
Vineyard		278.4	0.0	278.4
Pasture	X	0.0	61.0	61.0
Unknown agricultural	X	158.8	26.8	185.6
Fallow*	X	355.3	637.9	993.2
Sloughs and ditches		91.8	49.7	141.5
Ponds		1.5	105.7	107.2
Structures		12.6	1.5	14.1
Roads and landfills		73.1	18.7	91.8
Total		5,538.2	5,469.0	11,007.2
Total suitable for greater sandhill crane		1,751.3	4,849.7	6,601.0

* Fallow habitat consists of three separate types: fallow/sparse, fallow/dense, and fallow/levee slope. Fallow/levee slope habitat type was considered unsuitable for cranes and was subtracted (181 acres from Bacon Island and 166 acres from Webb Tract) from the total suitable habitat.

C-062402

Table 3-3. Greater Sandhill Crane Compensation Acreage Required for Losses of Habitat on the DW Project Islands

Island	Compensation Acreage
Bacon Island	1,751.3
Webb Tract	4,849.7
Bouldin Island	417.7
Holland Tract	9.0
Total	7,027.7

C-062403

Table 3-4. Greater Sandhill Crane Foraging Habitat Types Available on the DW Habitat Islands with Implementation of the HMP

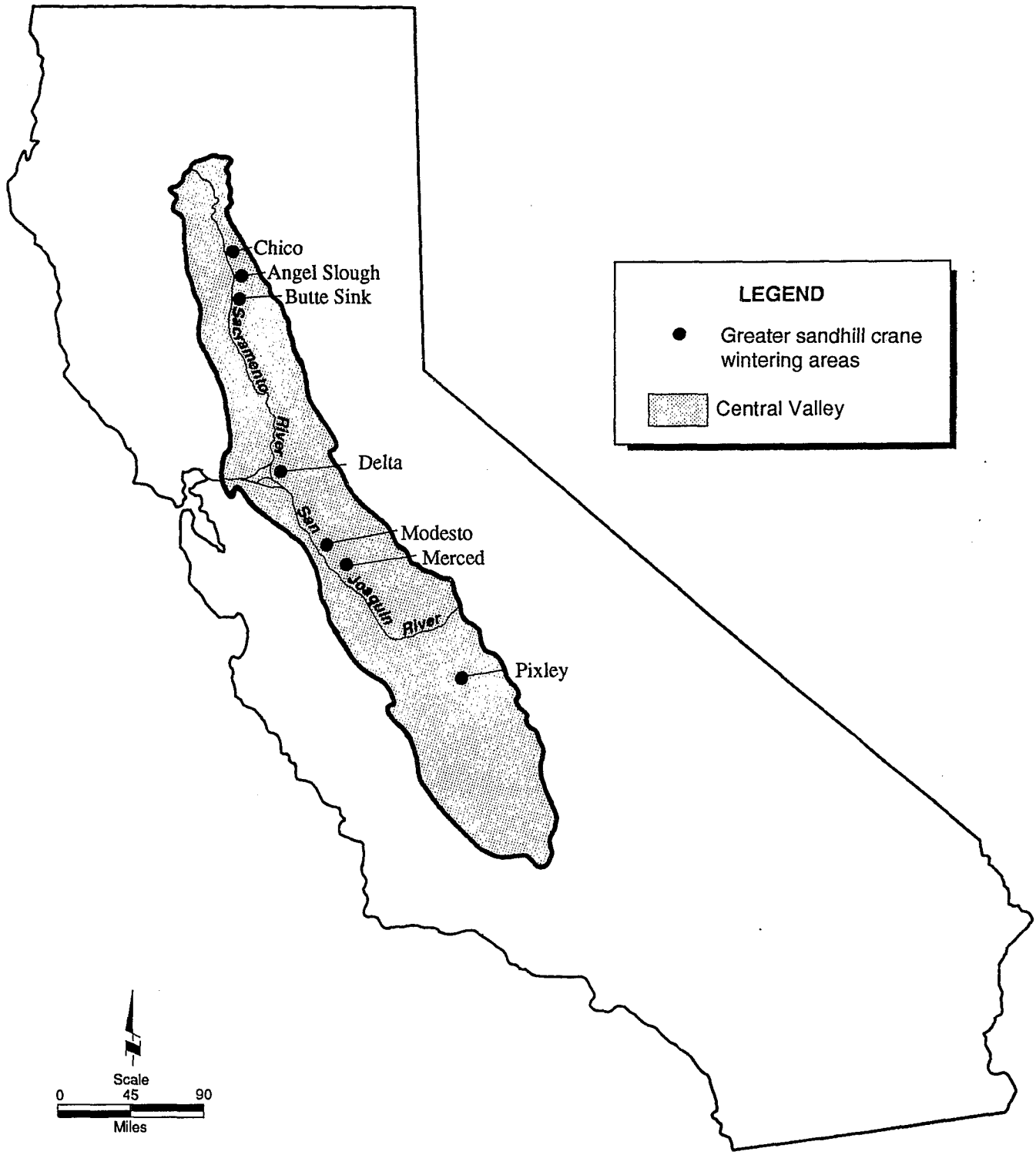
Habitat Type[a]	Bouldin Island	Holland Tract	Total Acres
Corn/wheat	1,629	955	2,584
Small grains	106	152	258
Mixed agriculture/seasonal wetland	1,014	631	1,645
Seasonal managed wetland	1,723	393	2,116
Seasonal pond	66	68	134
Pasture/hay	132	72	204
Herbaceous upland	479	253	732
Total	5,149	2,524	7,673

[a] Emergent marshes, seasonal ponds, and riparian woodland and scrub habitats, which provide little or no forage value for greater sandhill cranes, will also be developed on the habitat islands.

C-062404

Table 3-5. Greater Sandhill Crane HMP Strategies for the DW Habitat Islands

Management Goal	Management Objectives	Habitat Management Strategies
1. Provide suitable foraging habitat for wintering populations	A. Manage portions of harvested corn and wheat fields to provide optimal seed crop foraging conditions	1. Portions of each corn and wheat field, and mixed agricultural/seasonal wetland and seasonal wetland cells flooded to attract waterfowl should remain in a dry or shallow flooded condition (i.e., soil saturated to 2-inch depth) to provide suitable crane foraging habitat
	B. Manage portions of mixed agricultural wetland and seasonal wetland habitat to provide invertebrate, vegetative, and non-agricultural seed crop foraging areas	2. Portions of mixed agricultural/seasonal wetland and seasonal wetland cells and surrounding berms should be mowed prior to flooding to remove vegetative cover to create suitable foraging conditions
	C. Manage pastures to provide invertebrate foraging areas	3. Portions of pastures should be mowed prior to the arrival of wintering cranes and shallow-flooded to create suitable foraging conditions
2. Establish traditional wintering crane use areas	A. Attract cranes by managing a portion of suitable foraging and roosting habitats to minimize human disturbance	1. Close a portion of suitable foraging and roosting habitats to hunting to minimize human disturbance
	B. Manage some seasonal wetlands to provide suitable crane roosting habitat	2. Create suitable roost sites within closed zones by completely mowing selected seasonal wetland cells to reduce vegetation height and flooding the cells to depths of less than 4 inches



Source: Pogsdon and Lindstedt 1988.

Figure 3-1.
Winter Distribution of the Central Valley Population of the Greater Sandhill Crane

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Prepared by: Jones & Stokes Associates

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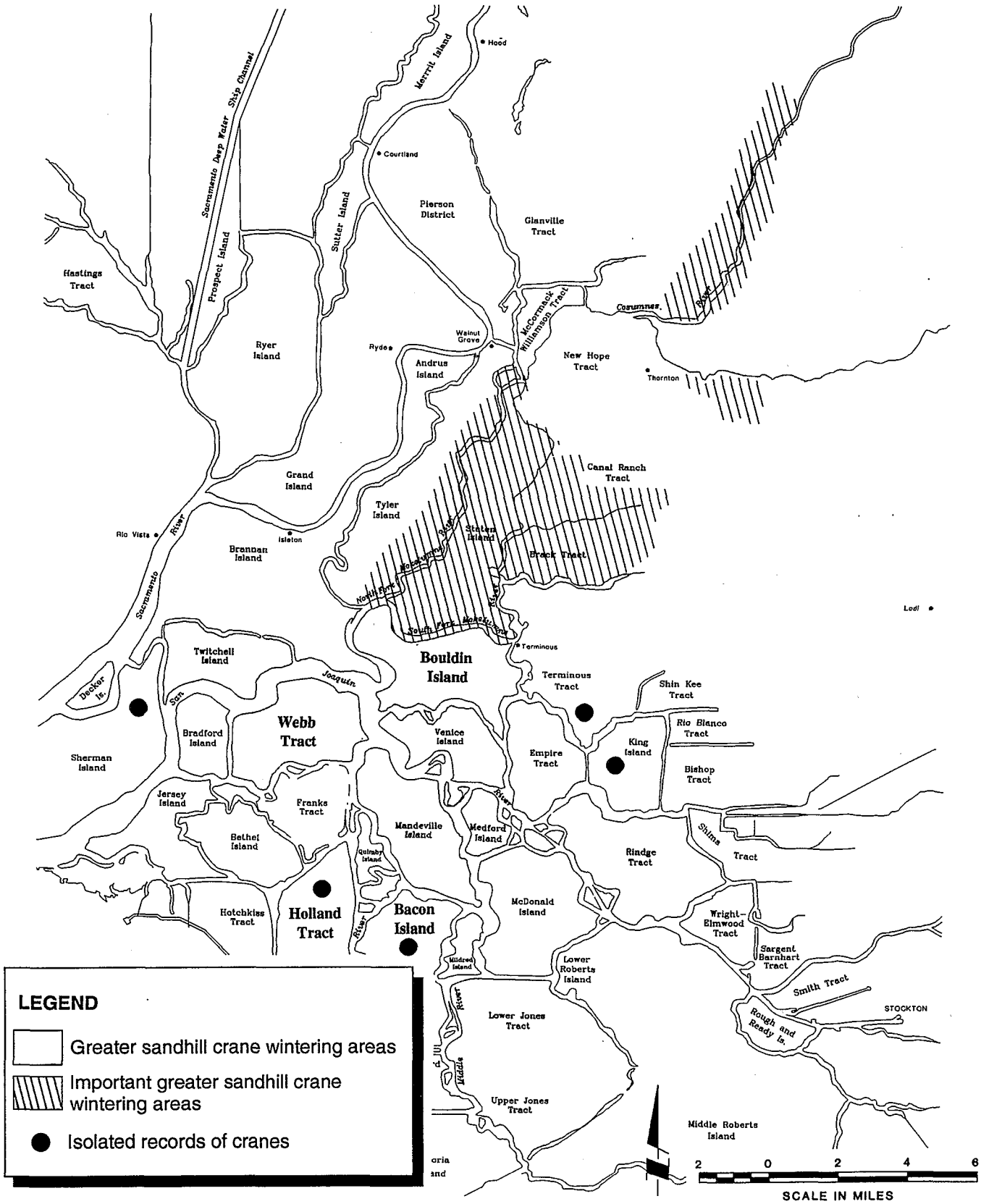

Source: Pogsdon and Lindstedt 1988.

Figure 3-2.
Distribution of Greater Sandhill Cranes in the Delta Region

DELTA WETLANDS PROJECT
Prepared by: Jones & Stokes Associates

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